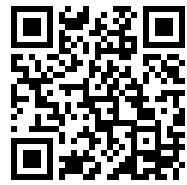

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AGRICULTURAL EXPERIMENT STATION OF THE
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BEVERLY T. GALLOWAY, Director
Department of Entomology

REPORTS ON SCALE INSECTS

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PREFACE

Among the more important insect pests of cultivated plants, and especially of fruit trees, are those of the family Coccidae, or scale insects, of which the San José scale is an example. An appreciation of this fact led the writer of the reports republished here to make a study of the insects of this family.

The investigation was begun in the year 1879, while the writer was Entomologist of the United States Department of Agriculture, and was continued after his retirement from that position, he being then Entomologist of the Cornell University Agricultural Experiment Station. Prior to the publication of its results no general work on the scale insects of the United States had appeared, the published accounts of these insects consisting of isolated descriptions of a few species. In the reports of the results of this study a monographic treatment of the family Coccidae is presented, the previously known American species are redescribed and figured, and forty new species are described. These descriptions are accompanied by detailed figures of the microscopic characters by which the different species are distinguished and which were first elucidated in the course of this investigation.

Excepting the catalogue of the Coccidae published by Mrs. Fernald — in which, however, there are no descriptions of species — these reports remain the only general treatise on scale insects published in the United States. They are, however, unavailable to most workers in economic entomology, as they have been out of print for a long time. Many requests for them have been received by the New York State College of Agriculture, and so urgent is the demand for this fundamental treatise that it seems wise to reprint the reports.

The first of these reports appeared in the Annual Report of the Commissioner of Agriculture for the year 1880 (pages 425 to 500); the second, in the Annual Report of the Commissioner of Agriculture for the years 1881 and 1882 (pages 501 to 506); the third, in the Second Report of the Cornell University Agricultural Experiment Station, published at Ithaca in 1883 (pages 507 to 603). The pagination, and the figure numbers and their sequence, of the original reports have been retained for the benefit of those who will find references to the original works. The regular page numbers of the Cornell bulletin series are also used, however, and these are placed at the top of the page, while the original page numbers, inserted for the benefit of librarians and research workers, are placed at the bottom of the page. Each cut bears below it, in parenthesis, the consecutive figure number of the Cornell experiment station publication.

REPORTS ON SCALE INSECTS

J. H. COMSTOCK

REPORTS ON SCALE INSECTS

(Including descriptions of Coccidae in the collection of the United States Department of Agriculture, with notes upon the habits of those injurious to cultivated plants, and the results of experiments in their destruction)

(From Report of U. S. Commissioner of Agriculture, 1880)

INTRODUCTION

There is no group of insects which is of greater interest to horticulturists to-day than that family which includes the creatures popularly known as "scale insects" and "mealy bugs." There is hardly any shrub or tree but that is subject to their attack; and in certain localities extensive orchards have been ruined by them. The minute size of the creatures, the difficulty of destroying them, and their wonderful reproductive powers, all combine to make them the most formidable of the pests of our orchards and ornamental grounds. It is only necessary to cite the mealy bugs of greenhouses, the oyster-shell bark louse of the apple, and the various species of scale insects destructive to citrus fruits to establish this fact.

Notwithstanding the great importance of the subject, comparatively little thorough work has been done on the species of this country. This is doubtless in a great part due to the difficulties attending a careful study of even a single species of this group, and the fact that the small size and plain appearance of the insects render them unattractive to most entomologists.*

This report on scale insects is an outgrowth of the investigation of insects injurious to orange trees, which was begun last year. In the early part of that investigation I became convinced that by far the greater part of the injury done to orange trees by insects was caused by scale insects; and that I could not do a more useful work than to make an exhaustive study of that family, including not merely those that infest citrus trees, but all the species occurring in the United States. I collected many of our southern species while on a trip through the State of Florida during the months of January and February, 1880; during the following summer I spent three months in the fruit-growing sections of California and Utah, investigating the scale insects found there; and extensive collections were also made by assistants and correspondents in the eastern part of the United States. A series of experiments were made to ascertain the best method of destroying these pests, and with very satisfactory results. These experiments will be continued during the present season. Many species, including all those that infest oranges in this country, were colonized on small trees growing in pots in the breeding room of the division. In this way we have been able to follow their complete life history. In some instances the species has been observed daily through five generations.

For want of time I have been unable to prepare descriptions of all the species which we have collected. I hope, however, to be permitted at some future time to publish a more exhaustive memoir on the subject, and trust that the reader will remember that this is simply the result

* Previous to this only about thirty species have been described by American writers; and of this number more than one-half were described by Dr. Asa Fitch, the first State Entomologist of New York.

of but little more than one year's study pursued with limited means (there being no special appropriation for it) and in addition to the ordinary duties of the division of entomology.

CHARACTERS OF THE COCCIDAE

The scale insects, or bark lice, and the mealy bugs, together with other insects for which there are no popular names, comprise the family known to entomologists as the Coccidae. This is a division of the order HOMOPTERA, to which belong also the plant lice (Aphidae), the cicadas, the leaf hoppers, and certain other insects.

We will not in this place enter into a discussion of the characters of the Homoptera or of the zoological relations of the Coccidae to the other families included in that order. But referring those who are interested in these points to the textbooks on entomology (see also report of this department for 1876, pp. 24–46), we will proceed at once to a discussion of the Coccidae.

In many respects this is a very anomalous group of insects, differing greatly even from closely allied forms in appearance, habits, and metamorphoses. Not only do the members of this family appear very different from other insects, but there is a wonderful variety of forms within the family; and even the two sexes of the same species in the adult state differ as much in appearance as insects belonging to different orders.

The most obvious characters in which the Coccidae agree, and by which they may be distinguished from other insects belonging to the Homoptera, are the following: the females never possess wings; the males are winged in the adult state, but unlike other homopterous insects possess only a single pair of wings, the second pair being represented by a pair of small club-like organs called halteres, each usually furnished with a bristle, which in all the species that I have studied is hooked and fits into a pocket on the anterior wing of the same side.* (See Plate XXI.) The male in the adult state has no organs for procuring food, the mouth parts disappearing during the metamorphoses of the insect and a second pair of eyes appearing in their place.

The strange forms assumed by certain species of bark lice has led to their being mistaken for very different organisms. Thus the adult females of a species of a genus of bark lice (Kermes) common on oaks in various parts of the world have been commonly mistaken for galls. A species of this genus is represented on Plate IX, figure 1; the gall-like objects on the twig of oak are the females; the immatured males are very different in form, and are represented on the leaves. The resemblance to galls is shared somewhat by certain other genera of this family. In fact, the family is termed by the French *Gallinsectes* on account of this resemblance.

There is a remarkable species belonging to this family found in the West Indies in the furrows of the land newly turned up, which from its resemblance to a pearl is known as the ground pearl, and is frequently sent to Europe in collections of shells under that name. It is stated by Guilding, who first described this insect (Trans. Linn. Soc. Lond., 1833, T. 16, P. 1, pp. 115–119) under the name of *Margarodes formicarium*,

* The relations existing between the halteres and the anterior wings were first observed by Mrs. Comstock while making drawings for this report. She has repeatedly seen a male in the act of replacing the hook of the bristle in the pocket from which it had been removed while the insect was being mounted for examination under a microscope. Our observations, however, have been too limited to enable us to state positively what is the function of the halteres; but we believe that they aid in flight.

that it occurs in the Bahamas, and is strung into necklaces and ornamental purses by the ladies. It was believed by Guilding that the ground pearls were parasitic on the ants, in and near the nests of which they were found. I think, however, that it is more probable that the so-called pearls derive their nourishment from the roots of plants in the soil, and that they, instead of destroying ants, furnish them with food in the form of an excretion, as many other species of Coccidae are known to do.

The habit of excreting a sweet fluid, which many species possess, together with the strange forms of the insects, has also led to some strange mistakes. Thus one species which occurs on pine was at first taken for a nectar-secreting gland (Unger, Flora, 1844, p. 713).

DIVISION OF THE COCCIDAE INTO SUBFAMILIES

Owing to the great diversity of form and structure among the species belonging to this family they may be grouped into several subfamilies; and such a grouping is necessary before generalizations can be made respecting the habits and metamorphoses of the various species. Signoret in his monograph of this family divides it into four sections.* We believe that each of these sections should rank as a subfamily, and will so consider them. They are characterized as follows:

I. DIASPINAE.— This subfamily includes all the species of Coccidae covered by a scale composed in part of molted skins and partly of a secretion of the insect.

Examples.— The oyster-shell bark louse of the apple (*Mytilaspis pomorum*), the red scale of the orange (*Aspidiotus aurantii*), and Glover's orange scale (*Mytilaspis Gloverii*).

II. BRACHYSCELINAE.— This subfamily includes certain species of Coccidae which live in galls. All the described species are Australian. Consequently the subfamily will not receive further notice in this report.

III. LECANINAE.— The original characters of this subfamily as given by Signoret are as follows: Species either naked or inclosed, or simply covered with waxy calcareous or filamentary material; most of the females after impregnation taking on a different form, and, once fixed, remaining so for the rest of their lives, although while young they retain the power of moving under certain circumstances.

IV. COCCINAE.— Signoret originally gave the characters of the Coccinae as follows: Females keeping the form of the body with the segments distinct until the end, and also retaining the power of motion; they are naked or covered more or less with a wavy whitish excretion, filamentary and more or less spumous.

These characters were afterwards found to be insufficient to separate the two groups as the genus Kermes which, from the study of the young larva, belongs evidently to the Coccinae, is fixed and covered with a hard horny substance, hiding the segmentation and giving it precisely the appearance of a Lecanium. Signoret therefore substituted the following characters: Lower lip 1-jointed in the Lecaninae, multiarticulate in the Coccinae; anal plates present in the Lecaninae, absent in the Coccinae; anal extremity with the Coccinae divided into two lobes, each furnished with a long bristle.

* Annales de la Société Entomologique de France, 1869, p. 98. We have not included the section Lecanodiaspis established by Targioni-Tozzetti, as all the representatives of it which we have been able to study have been found to belong to some one of the other sections.

Examples of Lecaninae.— The black scale of California (*Lecanium oleae* Bernard), the maple-bark louse (*Pulvinaria innumerabilis* Rathvon), the lac insect (*Carteria lacca* Ker.).

Examples of Coccinae.— The mealy bugs (Dactylopius), the cochenille insect (*Coccus cacti* Linn.).

METAMORPHOSES OF THE COCCIDAE

The changes through which a scale insect passes in the course of its development are very remarkable. But as the metamorphoses and habits of each division of the family are somewhat peculiar, it is necessary to consider each subfamily by itself. We will discuss in this place only the first subfamily.

1. THE DIASPINAE.— The newly-hatched scale insect is oval in outline, much flattened, furnished with six legs, a pair of antennae, and an apparatus for sucking the juices from plants. (See Plate III, fig. 2*c*, young of *Aspidiotus ficus*.) At this stage of its existence it is very small, a mere speck, which the untrained eye could only with difficulty detect. By means of a lens, however, these minute creatures can be seen crawling in all directions over the leaves or bark of an infested tree. After wandering for a time, usually but a few hours or even less, the young scale insect settles on some part of the plant, inserts its beak, and, drawing its nourishment from the plant, begins its growth at the expense of its host. In a short time there begins to exude from the body of the larva fine threads of wax, which are cottony in appearance. The excretion of this wax continues until the insect is completely covered by it. The rate at which this excretion is produced varies greatly. Thus larvae of the red scale of Florida (*Aspidiotus ficus*) which were only one day old were found to be completely covered by the cottony mass which they had excreted, while the larvae of Glover's scale (*Mytilaspis Gloverii*) did not become entirely covered until they were six days old. Sooner or later the larva begins to excrete a pellicle, which, although very thin, is dense and firm in texture. The mass of cottony fibers either melts or is blown away, or, as in certain species of Aspidiotus, a portion remains as a white dot or ring on the center of the scale. After a period, which in several species that we have studied is about one-half of the time from the hatching of the larva to the emerging of the male, or one-third of the time from the birth of the female to the date at which she begins ovipositing, the larva sheds its skin. In some species this does not take place until after the beginning of the formation of the permanent scale, and in such cases the molted skin adheres to the inner surface of the scale, and cannot be seen while it is in its normal position on the plant. This is true of many species belonging to the genus Aspidiotus (*A. ficus, A. citri, A. perniciosus,* and others).* In these species the position of the exuviae is indicated by a nipple-like prominence, often marked by a white ring or dot, which is the remains of the cottony mass first excreted. In other species the molt takes place before the beginning of the excretion of the permanent scale. In these the larval skin is plainly visible either upon the surface of the scale, as in certain species of Aspidiotus (*A. nerii,* Plate IV, fig. 1*c*) and in Diaspis (Plate V, fig. 1*a*, 2*a*), or at one extremity, as in Mytilaspis (Plate VII, fig. 1*a*). Sometimes, however, the larval skin is covered by a delicate transparent layer, which, I think, is the melted or compacted remains of the cottony mass excreted by the young larva (Plate VII, fig. 2*a*).

* For figures of *A. ficus* and *A. citri* see Plate III.

The change which the larva undergoes at this molt is a very remarkable one, appearing to be a retrogression instead of an advancement to a more highly organized form, as is the rule in the development of animals. With the skin are shed the legs and antennae.* The young scale insect thus becomes a degraded grub-like creature with no organs of locomotion. The mouth parts remain, however, in a highly developed state and are well fitted to perform their functions. This apparatus is not the least remarkable thing in the structure of these insects. It is terminated by a thread-like organ, which is frequently much longer than the body of the insect, and is composed of four delicate hair-like bristles. By means of this organ the insect is firmly attached to the plant and draws its nourishment therefrom. From this stage the development of the sexes differs.

The second and last molt of the female takes place, in those species which we have studied most carefully, when she is about twice as old as when the first molt occurred. The change in appearance at this molt presents nothing remarkable. The second cast skin is joined to the first and with it forms a part of the scale which covers the body of the insect. Sometimes, as in the genus Fiorinia (Plate XI, fig. 7), this molted skin is very large and constitutes the greater part of the scale; but more commonly the exuviae form but a small proportion of the scale, the greater part of it being excreted subsequently to the second molt. Soon after the second molt of the females takes place the adult males emerge, and doubtless the impregnation of the females occurs at once. After this the body of the female increases in size, becoming distended with eggs. The oviposition takes place gradually, and in those species that we have studied begins when the female is about three times as old as when the first molt occurred. In other words, the three intervals between the birth of the female and the first molt, between the latter and the second molt, and between this and the beginning of oviposition are about equal. The eggs are deposited beneath the scale, the body of the female gradually shrinking and thus making room for them. (See Plate VII, fig. 1*b* and 2*c*.) Some species, however, are viviparous.

The male scale insect during the early part of its larval life is indistinguishable from the female. The first molt occurs at the same time and is accompanied by a similar change, the male larva like the female losing its legs and antennae. The second molt is also synchronous with the second molt of the female; but here the similarity in form between the two sexes ceases. Even before this molt takes place there may be observed the formation of rudimentary limbs beneath the transparent memberless skin of the larva; and after this skin is shed the male, now in the pupa state, differs remarkably from the female. The male pupa has long antennae, and its legs and wings, although in a rudimentary state, are very large. The duration of the pupa state in those species which we have bred is short, lasting but a few days; and then after a third casting of the skin the adult male appears.

The outline figures on Plates XXI and XXII represent the insect in this stage. The anterior wings, though very delicate, are large, and enable the male to fly readily. The posterior wings are represented only by a pair of halteres. These insects resemble in this respect the flies, gnats, and other insects belonging to the order Diptera, or two-winged insects. The posterior end of the body is furnished with a style which is sometimes nearly as long as the remainder of the body, and is the external

* Rudiments of antennae are sometimes retained, as in certain species of Mytilaspis.

organ of reproduction. As our figures represent only a dorsal view, the most remarkable character of the adult, the supplementary eyes which take the place of the mouth parts, is not shown.

EXPLANATION OF CHARACTERS USED IN CLASSIFICATION OF THE COCCIDAE

Many members of this family differ so greatly from the ordinary forms of insects that in classifying them it becomes necessary to use characters peculiar to them. This is especially true of the subfamily Diaspinae, where the scale and the last segment of the female present nearly all of the tangible specific characters. Much stress has been laid by certain writers upon the characters presented by the male. But, although we have done our best, we have found little in this sex that is of value for separating closely allied species that can be put into words. We have bred the males in much greater numbers both of species and of specimens than has ever been done before by a single student. These have been figured very carefully, the drawings being made on a large scale and reduced by photography. Great care has been taken to represent accurately the shape and relative size of the different parts of the body. The results of our labor in this direction are given with the hope that in the future they may be found of more value than appears to us now. The disappointment which we have experienced in the study of the males has been relieved by the success which has attended our study of the margin of the last segment of the females of the Diaspinae. Here we have found a set of characters which have received almost no attention heretofore, but which are almost the only ones which can be relied upon for separating closely allied forms.*

SCALE.— The term *scale* is applied to the thin pellicle which covers the dorsal surface of the bodies of all the Diaspinae. It is composed in part of molted skins, of which *two* are attached to the scale of the female, and *one* to that of the male; these are termed the *exuviae.* There is also a layer composed of excretion, and, in some cases at least, of the ventral half of the molted skins between the body of the insect and the bark of the plant upon which it is. This layer varies greatly in thickness and presents in some instances specific characters. I do not find that it has been noticed by authors. In the descriptions of species I have termed it the *ventral scale.*

LAST ABDOMINAL SEGMENT.—As stated under the head of *Metamorphoses,* the members of the subfamily Diaspinae undergo a remarkable change at the time of the first molt, losing their legs and antennae, and thus becoming apparently less highly organized than in the larval state. At the same time the last abdominal segment assumes a remarkable form, becoming flattened and fringed with numerous appendages. In the male this character is transient; the form of this segment changing gradually, previous to the second molt, to that which it bears in the

*Although I have endeavored to so describe and figure the more important species of scale insects that they may be easily recognized by any careful reader, still I am forced to state that in many cases it is useless to try to separate closely allied species by a study of the scale alone. The most reliable characters are presented by the spinnerets, and the fringing lobes, plates, and spines of the caudal segment of the adult female. In the study of these characters good work can only be done with the best of apparatus. The specimens must be carefully mounted and examined with a good microscope using a one-fifth inch objective or a higher one. We have used for our finest work a Hartnack No. 9 (equivalent to one-eleventh inch Am. objective) and a No. 5 eye piece; this combination gives a magnification of about thirteen hundred diameters.

pupa state. In the female, however, this segment becomes hardened apparently by the deposition of chitine, and the peculiar form is preserved throughout the remainder of the insect's life. In fact, so completely are these parts chitinized that their peculiar forms are preserved even after the insect is dead and the remainder of its body is so shriveled as to be unrecognizable.*

The very careful study which we have made of this segment and its appendages, embracing an examination of several thousand mounted specimens, has demonstrated that the characters here presented are very constant within the limits of each of the species which we have investigated. In fact they are the only characters upon which we have been able to place implicit confidence in separating closely allied forms. I have therefore given considerable space in the description of species to these characters. In each case the description has been based upon a study of the adult female.

Upon the dorsal surface of the segment are usually several lines of holes which are the openings of glands which execrete a part at least of the substance of which the scale is composed. I have studied specimens in which there was a thread of excretion extending from each of these openings to the scale. Although these openings are very prominent I have failed to find that they present specific characters, and so have made no use of them in classification; and have figured them in but few instances. In the more transparent species they are easily seen through the body when examining it from the ventral side, and unless a good microscope be used, the openings of the two surfaces will be confused. Near the center of the ventral surface of this segment is the *vaginal opening,* which is large, and which is represented in nearly all of our drawings of this segment.

In most species there is a greater or less number of peculiar openings arranged in groups around the vaginal orifice. These are termed *spinnerets* (*filières*) by Signoret, a term which is also applied to various other openings, tubes, and tubular spines which occur on this and other segments of the body, and which are supposed to be openings to glands which excrete the covering of these insects. The pores which are arranged in groups about the vaginal opening differ remarkably from others in being compound, each spinneret being a circular plate perforated by several small openings.†

The presence or absence of these spinnerets, the number of them in each group, and the number of groups, are characters of some value in classification. They cannot however be relied upon implicitly. The number of spinnerets in each group varies more or less in every species, and even upon the two sides of the body of the same individual. But as this variation is usually quite limited it does not render this character valueless. In most species the number of the groups of these spinnerets is either four or five. When they are five, one is situated cephalad of the vaginal opening, and two on each side of it. These groups I have designated as the anterior, anterior-lateral, and posterior-lateral, respectively. When there are only four groups, it is the anterior one that is wanting. Other forms of grouping of the spinnerets exist and will be described in the descriptions of the species in which they occur. On the posterior margin of the segment are situated numerous

* In one instance I removed from under their scales the dried bodies of scale insects which had been in a collection for twenty-five years, and found that the characters presented by this segment were perfectly preserved.

† I have observed similar compound spinnerets near the base of the oral setae in several species (*C. furfurus* and *P. pergandii*).

appendages of which three forms may be distinguished; these I have termed lobes, spines, and plates.

The *lobes* are usually the most conspicuous of the appendages of this segment. They appear to be inserted in a groove between the posterior edges of the upper and lower surfaces of this segment. But in two species which I have succeeded in dissecting (*A. obscurus* and an undescribed species) I found each lobe to consist of a prolongation of the margins of the dorsal and of the ventral walls of the segment; these prolongations being much thickened and joined at their distal extremities. This thickening of the body wall extends anteriorly for a short distance upon both the dorsal and ventral sides of the body, but chiefly upon the former. The number of these lobes varies from one to four pairs.

In some species a part of the *lateral margin* of the segment appears to be of the same structure as the lobes.

In certain species *thickenings* of the body wall occur near the prolongations of the lobes but more or less distinct from them. In each of the species which I have dissected these thickenings are on the dorsal side of the body; this point can be determined only by splitting the specimen and studying the dorsal and ventral halves of the body separately. In an unmutilated specimen the thickenings of the body wall appear like organs within the body. The number, size, and position of these thickenings afford good specific characters.

In certain species the posterior margin of the segment is incised two or three times (usually twice) on each side of the meson. These *incisions* and the edges of them (which are usually thickened) afford characters of importance. As with the thickenings described above it is difficult to determine from an unmutilated specimen upon which surface these incisions are. They are represented in all of our drawings as they appear when seen from the ventral side.

The *spines* are situated near the posterior margin of the segment. There are usually two, one on the dorsal surface and one on the ventral surface, associated with each of the lobes. Others are situated at various intervals between the lobes and the penultimate segment. In many instances these spines appear to be tubular; and I have repeatedly seen what appeared to be threads extending from them; hence they may be spinnerets.

In the descriptions the lobes and spines are numbered, beginning at the meson, the corresponding lobes of each side of the body bearing the same numbers. They are thus considered in pairs; as are the legs and wings of other insects, excepting that in numbering the lobes and spines the numbers increase cephalad instead of caudad.

Under the head of *plates* I have classed all the remaining appendages which fringe this segment. They are usually long, flattened, and more or less notched or toothed. Sometimes, however, they are hair-like or spine-like. This is especially the case on the side of the segment; here, too, the form and number are not so constant as it is between the lobes. When studying the ventral surface of this segment a clear spot on the middle line of the body is usually visible. This is the *anal opening*, and is really on the dorsal surface of the segment; its apparent position is represented in the figures, and as will be readily seen varies greatly in different species.

There are many other openings and appendages of this segment which we have not represented in our figures, as no use has been made of them in classification, and the representation of them would only tend to confuse the illustrations.

TERMS DENOTING POSITION OR DIRECTION OF ORGANS

The use of the terms upper, lower, inner, outer, before, behind, and similar expressions in the technical descriptions of animals, or of their parts, has led to so much confusion that there is a strong movement on the part of the leading zoologists in favor of a more exact anatomical nomenclature.* Although many of the terms proposed may never be adopted, others which are obviously appropriate, definite, and concise are rapidly coming into use. A few terms of this class are introduced into this report. The position and direction of all parts and organs are referred to an imaginary plane dividing the body into approximately equal right and left halves. This middle plane or any line contained therein is designated as the *meson*. The corresponding adjective is *mesal*, and the adverb *mesad*. In combination *meson* becomes *meso*. The well-known adjectives *dorsal, ventral, dextral, sinistral, lateral, proximal, distal, cephalic,* and *caudal* are used in preference to less definite terms, as are also the corresponding but less familiar adverbial forms, *dorsad, ventrad,* and so on.

METHODS OF PREVENTING THE SPREAD OF SCALE INSECTS

The facts given above suggest the following methods of preventing the spread of scale insects to orchards and other cultivated grounds not already infested by them. In planting an orchard, choose as isolated a spot as practicable, so as to be able to control as fully as possible the conditions upon which the introduction of pests depends. If isolation cannot be obtained, an effort should be made to induce the owners of neighboring orchards to join in the determination to grow clean fruit. The greatest care should be used in the purchase of trees and in the importation of buds. Before planting, thoroughly wash all such trees with some substance, as a strong solution of soap, which will destroy insects without injury to the trees; buds and scions brought from other orchards should be treated in the same way before using. The fact that trees or scions appear free from pests should not deter one from using the utmost precaution, for the untrained eye would fail to detect the early stages of these insects. Do not visit infested orchards unnecessarily; and, above all things, do not carry home specimens of scale insects as curiosities. The trees should be watched carefully, and if one is ever found to be infested with scale insects it should be destroyed at once. Remember that no better investment can be made than to burn such a tree, and that no other time is so good for doing it as the day it is first found to be infested. The system of exchange of fruit boxes which is practiced in some markets, notably in San Francisco, is a very dangerous one. Each shipper should have his boxes marked, and insist on not receiving boxes belonging to other shippers. And in any case when boxes are sent to a market where fruit from infested orchards is received they should be scalded on their return. This precaution will tend to check the spread of the codling moth and other pests as well as scale insects.

The use of fertilizers is often recommended as both a preventive of the attacks of scale insects and a remedy to be used when an orchard becomes infested. The general testimony of fruit growers is that sickly trees are much more liable to be attacked by scale insects than those which are healthy. Doubtless, in many instances, the effect of the

* See paper by Dr. Burt G. Wilder on "A Partial Revision of Anatomical Nomenclature," Science, vol. II, pp. 122–133.

presence of insects has been considered the cause; but in other cases, some of which have come under my observation, the sickly condition of the tree has certainly preceded the attacks of the insects. It is difficult to explain these phenomena, unless we suppose that the sap of a sickly tree is in some way more nutritious than that of a vigorous tree, for the period during which these insects can travel is so limited that they are not able to make a choice of food plant, but must, under ordinary circumstances, live or die on the plant upon which they were born. Let the explanation be what it may, the fact remains that vigorous trees are less liable to become infested by scale insects. I have also been assured by many fruit growers, and some of them men of broad experience and close observation, that by stimulating the growth of an infested tree, "the tree will throw off the scale insects." As to this I cannot speak from personal experience. But testimony of this kind is so general that I am inclined to believe that it has considerable foundation in fact. Moreover, this theory is simply the converse of the one that sickly trees are more subject to the attacks of this class of insects. In any case, be these theories true or not, a healthy tree will be better able to withstand the attacks of insects, and the use of fertilizers will aid a tree in recovering from the enfeebling effects of such attacks.

METHODS OF DESTROYING SCALE INSECTS

In many cases these pests have gained such a foothold that the destruction of a small number of trees would not suffice to free the orchards from them. And hence, to accomplish our purpose, it is necessary to be able to destroy the insects without injury to the infested trees. During the past year I have conducted many experiments with various substances which have been recommended for this purpose. In every case care has been taken to note the effect upon the plant of the substance used, as well as its efficacy as an insecticide. Next in importance to these considerations are the cost of a substance, and the relative ease with which it may be applied. These have also been carefully considered.

From the suctorial habits of this group of insects, the remedies available are evidently limited to such as destroy life by simple contact, and such as produce death when inhaled through the spiracles. The large class of poisons which require to be swallowed with the food of the insect are useless, as the food is taken from beneath the surface of the tissues of the plant, and hence beyond the reach of external applications to the plant.

Methods of applying remedies.— Certain species of scale insects confine their attacks to the bark of the trunk and larger limbs of the trees which they infest. These are very easily reached. The best method is to apply the substance used with a stiff brush, by means of which many insects may be destroyed mechanically, and the remedy brought in contact with others which are under the loose bark of the tree, and would thus be liable to escape if the remedy were applied otherwise.

But the greater number of species of this family of insects infest the bark of the smaller branches and the foliage. To reach these is a difficult matter. It can be done best by means of water and some form of force pump; the remedial agent being diluted with water and the mixture then sprayed upon the infested plants. The pump which I have used in my experiments is figured in Report for 1879, Plate XIV, consists of two brass tubes, one working telescopically within the other; a hose is fastened to one end and a rose can be attached to the other; this

rose is represented in the lower part of the figure; an arrangement of valves allows water to pass into the pump through the hose, but will not allow it to return. Thus, when the smaller tube is pulled out, the pump is filled to its greatest capacity; by pushing this tube back, the water can be ejected with considerable force through the rose in a fine spray. By using a nozzle with a single opening, such as is represented upon the pump, a stream can be thrown a greater distance. In this way the topmost leaves of any orchard tree can be reached. In applying liquids on a large scale, as upon extensive orchards, the work can be done rapidly by placing the mixture in a barrel upon a wagon, and pumping directly from this barrel. In case expensive solutions are used it will probably be found desirable to collect that part which drops from the tree while the application is being made. For this purpose an apparatus can be made of canvas or strong cotton cloth supported by a frame and so arranged that the liquid which falls on it will flow into a receptacle, and can thus be used again. In addition to the saving of the liquid which falls from the tree, the use of an apparatus of this kind would tend to cause the more thorough application of the remedy, as the operator would feel that what was not necessary to wet the trees would fall off and thus be saved. The great difficulty of wetting every part of the tree by a single application will in most cases render several applications necessary.

REMEDIES WHICH HAVE PROVED PRACTICABLE.— Although many substances have been recommended for the purpose of destroying scale insects, the results of our experiments tend to show that in most cases these substances are of but little value. A few of the agents, however, have been found to be both efficient and practicable. These are as follows:

Soap.— The value of soap as an insecticide has long been known; and the experiments which I tried with it were made chiefly for the sake of comparison with those made with other substances. The results, however, were so remarkable that I feel warranted in saying that taking into consideration its efficiency as a means of destroying scale insects, its effect upon plants, and its cost, there is at this time no better remedy known than a strong solution of soap. In my experiments whale-oil soap was used, and the solution was applied by means of a fountain pump to orange trees infested with the red scale of California. In the strongest solution used the proportions were three-fourths pound of soap to one gallon of water. The mixture was heated in order to dissolve the soap thoroughly; and the solution was applied while yet heated to about 100° F. The tree upon which the experiment was made was very badly infested, the bark of the trunk being literally covered with scales. Four days after the application of the solution I examined the tree very carefully and could find no living insect on the trunk of the tree, and only a small proportion of the coccids on the leaves appeared to be still alive. I was unable to examine the tree again personally, but three months later Mr. Alexander Craw, of Los Angeles, made a careful examination of this and some other trees upon which we had experimented, and on this one *he was unable to find any living scale insects.* Taking into consideration the extent to which this tree was infested, and the fact that but a single application of the solution was made, the result is remarkable.

In another experiment the solution was made as in the above and then an equal amount of cold water added. The tree experimented upon was similar to the one used for the former experiment. Four days after the application no living insects could be found on the trunk of the tree, and only a very few upon the leaves. In fact, the experiment was as

successful as could be expected, it being very difficult to reach every insect on the leaves by a single application. When Mr. Craw examined this tree three months later he found but few living insects on it.

As a result of all of my experiments with soap, I recommend the use of it in the proportion of one-fourth pound of soap to one gallon of water, repeating the application after an interval of a few days. If a cheap soap be used, which can be obtained for from four to six cents per pound, the cost of the remedy will not be great compared with what is to be gained.

Kerosene.— This is the best and cheapest of all agents for the destruction of insects where it can be applied without injury to crops or other property. But the injurious effects which are liable to follow the use of it when applied to living plants detracts greatly from its value. To what extent it can be safely used has not yet been fully determined.

We have tried many experiments but the results are not uniform. Spraying kerosene upon the leaves of cotton killed the plant. The bark of elm trees around which bands of felt saturated with kerosene had been applied was destroyed whenever the oil reached it.

In Jacksonville, Fla., I was shown orange trees the trunks of which had been wet with kerosene to destroy the scale insects, and the experiment resulted in the destruction of the greater part of the bark to which the oil had been applied. On the other hand, I have repeatedly applied the pure kerosene to the leaves of orange without any apparent result; even a young shoot, which although two feet in length was not more than fourteen days old, was uninjured by an application of pure kerosene which thoroughly wet every leaf so that the oil flowed from them in large drops. A bark louse (*Lecanium hesperidum*) which was very abundant upon ivy on the department grounds was destroyed by the application of pure kerosene with no apparent bad results to the vine.

The experience of Mr. Saunders in the use of kerosene in the orange house of the department has extended through several years. He gives the results of his experiments as follows*:

Several years ago the department imported from Europe a collection of the Citrus family, embracing many varieties of the orange, lemon, lime, &c. The plants were in a very bad condition when taken out of the packages, owing to detention on the voyage and other causes; most of them were denuded of foliage and very scant of roots. They were at once planted in pots and placed under suitable conditions for growth. It soon became evident that they were badly infested with a scale insect which greatly retarded their growth and prevented their propagation and distribution. After the failure of many attempts to utterly eradicate this insect, the collection may now be said to be entirely rid of it. This has been effected by the persistent use of a small portion of coal oil applied in water. About one gill of astral oil in five gallons of water applied to the plants through a syringe on alternate days for several months has destroyed the insects without injury to the plants; weaker solutions seemed ineffective, and when the oil was increased to an appreciable degree, the young leaves and tender shoots of the oranges were injured.

The success attending Mr. Saunders's use of coal oil is due, I believe, to more persistent efforts than most horticulturists would be willing to make. Not only was the remedy thoroughly applied, but it was found necessary to repeat the application very many times.

The following experiments indicate what may be expected from single applications of this remedy:

A single application of kerosene and water, in the proportions given above, to a lime tree, destroyed only a small part of the scale insects upon it. One part of kerosene suspended in one hundred and fifty parts of water was atomized over *Lecanium hesperidum* on ivy, but no

*Report of Department of Agriculture, 1878, p. 205.

effect on the insects or foliage was discoverable, although the plant was examined daily for several weeks. Some of the same mixture was applied to mealy bugs on young orange leaves with no results. One part of oil to seventy-five of water was similarly used, but neither the insects nor the foliage were injured. One part of oil to fifty parts of water was equally inefficient when applied to Lecanium. A small quantity of pure kerosene was then atomized over the scale insects on ivy. Four days later the insects were found to be dead and the vine uninjured. The experiment was repeated with similar results. Pure kerosene sprayed over a colony of the woolly apple-louse (*Schizoneura lanigera*) killed the insects at once without injuring the branch of Crataegus upon which they were.

Many experiments similar to the last two were tried with similar results. Still, I am unwilling to recommend the use of pure kerosene upon living plants.

The application of kerosene mixed with water is attended with obvious difficulties. The method adopted by Mr. Saunders is to place the kerosene and water together in a pail or tub, and then thoroughly mix the liquids by syringing a syringeful into the barrel several times and then, filling the syringe quickly, throw the mixture upon the trees before the oil and water separate. The great trouble attending this method of applying kerosene has led to many efforts to make an emulsion of this substance. As to the result of these efforts Professor C. V. Riley made the following statement in the Scientific American of October 16, 1880:

> Nothing is more deadly to the insect in all stages than kerosene or oils of any kind, and they are the only substances with which we may hope to destroy the eggs. In this connection the difficulty of diluting them, from the fact that they do not mix well with water, has been solved by first combining them with either fresh or spoiled milk to form an emulsion, which is easily effected; while this in turn, like milk alone, may be diluted to any extent so that particles of oil will be held homogeneously in suspension. Thus the question of applying oils in any desired dilution is settled, and something practicable from them may be looked for.

Soon after the publication of this article I planned experiments based upon the statement in it to ascertain definitely what proportion of kerosene suspended in water by the aid of milk was most desirable for use in the destruction of scale insects. I found at once that the emulsion of milk and kerosene which I made could not be diluted with water to any great extent. Fully realizing the importance of the matter, I then made a series of more than fifty very careful experiments in order to ascertain how the desired dilution of the emulsion could be obtained. The results of these experiments were as follows:

An emulsion of kerosene and milk can be easily made by placing the fluids together in a bottle and shaking them violently for several minutes; about three minutes is the time usually required. The quantity of milk used should be at least equal to that of the kerosene. The best results were obtained when the kerosene formed only one-third of the mixture, but equal parts of kerosene, milk, and water gave as good results as one part of kerosene to two parts of milk.

For example, in one series of experiments I was unable to make an emulsion of equal parts of oil and milk; but by the addition of a third part of *either water or milk* I was able in each case to make a good emulsion. These emulsions were of a thick creamy consistence, and were very stable, no indication of a separation of the oil from the milk in one case, or from the milk and water in the other, being observable even after the emulsion had stood twenty-four hours. But as soon as water was added to the emulsion in any considerable quantity the oil

or the oil and milk together floated on the surface of the water; and no amount of shaking would serve to mix the liquids so that the mixture would be stable. It is true that in some of the experiments the emulsion separated from the water less readily than oil alone would; but in each case the mixture was of such a nature that it was necessary to stir it constantly in order to keep the oil suspended in the water.

Cole's Insect Exterminator.—This is the name given to a compound which is in the market and which is highly recommended as an insecticide. Its cost is too great, however, to admit of its use except on a small scale, as in conservatories. The results of our experiments show that it is very effectual as an insecticide, and that it is harmless to growing plants, thus being all that is claimed for it. An analysis of it shows that it may be closely copied by dissolving 2 to 2.5 per cent of green soap in 100 parts of 50-per-cent alcohol.

Tobacco.— A decoction of tobacco made by steeping .5 gram of Durham smoking tobacco in 15 cc. of water was fairly successful. Where tobacco can be obtained cheaply it is likely to prove of practical value for the destruction of scale insects; at least it merits a fair trial on a large scale in the field.

Snuff and sulphur.—Equal parts by bulk of smoking tobacco and flowers of sulphur were ground together in a mortar till thoroughly mixed. This compound was perfectly successful when dusted over *Lecanium hesperidum* when wet; and it adhered to the plant for a long time notwithstanding rain. Still this does not seem to me to be a remedy that will admit of successful and economical application on a large scale. It may be useful in conservatories, and upon ornamental plants.

Lye.—A small number of experiments were tried with lye; these were only partially successful. I found later, however, that lye has been used to a considerable extent in the vicinity of San José, Cal., with good results. Dr. Chapman, of that city, recommends* the use of concentrated mercantile lye in the proportion of one pound of lye to from two to four gallons of water, but suggests that the strongest solution should only be applied when the tree is dormant. I saw most excellent results in the orchard of Mr. V. C. Mason from the use of the following mixture: One pound concentrated lye, one pint gasoline or benzine, half pint oil, five gallons water.

Results of experiments with other substances.—By far the greater number of the substances with which we experimented proved to be of little or no value. In the case of some of them which have been very widely recommended by the agricultural press, we give the results of our experiments. These results are important, as they will enable the horticulturist to avoid loss of time and money in the application of inefficient substances.

Pyrethrum.— Through the kindness of Mr. G. N. Milco, of Stockton, Cal., I was furnished with an abundant supply of this valuable insecticide, and I made more careful and extended experiments with it than with any other substance. As a result of these experiments I am forced to state that, although for the destruction of certain classes of insects there is nothing better than a good quality of fresh pyrethrum powder, for the destruction of scale insects it is of very little, if any, value.

Dry pyrethrum was blown over the leaves of a tree badly infested with *Lecanium hesperidum* and *L. oleae*; so large a quantity of the powder was used that the upper surface of the leaves was made yellow with it. Although the coccids were young, many of them still crawling over the

* Pacific Rural Press, April 9, 1881.

surface of the leaves, but few were killed by the powder; and since many lady-bug larvae (Coccinellidae) which prey upon these coccids, and many specimens of a chalcis fly (*Tomocera californica*) the larvae of which destroy the eggs of the black scale (*L. oleae*) were destroyed by the powder, the application of it appeared to do more harm than good. During this experiment, which was in the open air in Southern California, a layer of paper was spread upon the ground under the tree. In about ten minutes after the application of the powder the chalcis flies and coccinellid larvae began to fall upon the paper, and I believe that the number of these beneficial insects which were destroyed was greater than the number of coccids.

Infusions were made in numerous ways, with hot water and with cold, by steeping and by boiling, and of various strengths. In some the proportion of pyrethrum was nearly one-fourth pound to the gallon of water. Although the infusions were more destructive to coccids than the dry powder, in no case were they sufficiently so to be considered successful, especially when the fact that the cost of the infusion was from ten to fifteen times as great as the cost of a solution of soap which was much more efficient.

The tincture of pyrethrum was found to be much more effectual than either the infusion or the dry powder; but the cost of making a tincture precludes its use on a large scale. A tincture of the *leaves and stems* of pyrethrum was furnished me by Mr. Milco. This also was found to be very efficient; which is a very interesting fact, as it indicates that the active principle of the plant is not confined to the flowers, a point worthy of further investigation.

Alcohol.— Commercial alcohol sprayed over scale insects produced no apparent effect. The experiments were tried for the sake of comparison with those made with tinctures, in order to ascertain if the greater efficiency of the tinctures was due to the presence of the alcohol with which they are made.

Ammonia.— Dilute *aqua ammonia* was found to be valueless for the destruction of coccids, as it injured the plants more than the insects.

Carbolic acid.— A large number of experiments were tried with aqueous solutions of carbolic acid. This substance was found to be of little value in destroying coccids and quite liable to injure the foliage of the plants.

Sulphur.—Although this substance is very useful for destroying the mycelium of fungi, our experiments indicate that it possesses little value as an insecticide. It forms, however, the basis of a large part of the nostrums used by the quacks who doctor fruit trees. A common way of applying it is to bore a hole, often one inch in diameter and six inches deep, into the trunk of the infested tree; then, after putting a considerable quantity of flowers of sulphur into this hole, it is closed with a wooden plug. It is claimed that the sulphur will be taken up by the sap and carried to every part of the tree, thus reaching and destroying every insect pest that infests it. Apparently no account is taken of the important facts that the sulphur is usually placed far inside of the cambium layer, and consequently where there is but little if any circulation of the sap; and that as sulphur is insoluble in water, it would not be taken up by the sap even under the most favorable circumstances.*

* I removed from an orange tree in Florida a quantity of flowers of sulphur which had been placed in it in the way described two years previously. The sulphur was unchanged in nature, and, as I was assured by the owner of the tree, undiminished in bulk.

USEFUL PRODUCTS OF THE COCCIDAE

Although the occasion for this report is the great injury to agriculture caused by certain species of scale insects, or bark lice, it should be borne in mind that there are insects belonging to this family which are beneficial to man. In some instances these insects or their products have been of great commercial importance, especially in ancient times; and to this date the products of certain species are used extensively.

The dyestuff known as kermes, or *Granum tinctorium,* is made from the dried bodies of the females of *Coccus ilicis* of Linnaeus, a species of bark louse which lives upon a small evergreen oak (*Quercus coccifera*), a tree which is native of Asia and the countries bordering on the Mediterranean. This dye has been in use ever since the time of Moses; and Pliny states that the inhabitants of Iberia paid to the Romans half their tribute in kermes. The use of this dye has, however, been superseded to a great extent by cochineal, which gives colors of much greater brilliancy. Cochineal is also an insect belonging to this family; it is the *Coccus cacti* of authors, and is a native of Mexico. It feeds upon various species of the Cactaceae, more especially *Opuntia coccinilifera.* Although this insect is a Mexican species, it is now cultivated in India, Spain, and other countries, and I have received living specimens which were collected upon a wild cactus near Fernandina, Fla. The dyestuff consists of the female insects, which, when matured, are brushed off the plants, killed, and dried. The entire insect is used. From cochineal, lake and carmine are also prepared. Cochineal is now being superseded by aniline dyes, which are made from coal tar.

The scarlet grain of Poland (*Porphyrophora polonica*) is still another bark louse which has been used to a considerable extent as a dyestuff.

The stick-lac of commerce, from which shell-lac, or shellac, is prepared, is a resinous substance excreted by a bark louse known as *Coccus lacca* (*Carteria lacca* Ker.), which lives upon the young branches of several tropical trees, especially *Ficus Indica, F. religiosa,* and *Croton lacciferum.* And the coloring agent known as lac dye is also prepared from stick-lac.

Another true lac insect occurs in Arizona upon the stems and branches of *Larrea mexicana.* Judging from the specimens in the museum of this department, the lac occurs on this plant in sufficient quantity to be of economic importance.

A bark louse which was described under the name of *Coccus manniparus* (*Gossyparia maniparus* Sign.), "is found upon *Tamarix mannifera* Shr., a large tree growing upon Mount Sinai, the young shoots of which are covered with the females, which, puncturing them with their proboscis, cause them to discharge a great quantity of a gummy secretion, which quickly hardens and drops from the tree, when it is collected by the natives, who regard it as the real manna of the Israelites" (Westwood).

China wax is another substance for which we are indebted to this family. It is the excretion of an insect known as Pe-la (*Ericerus Pe-la* Westwood). In fact, many species of this family excrete wax in considerable quantities. I have found three species in this country which, if they can be easily cultivated, produce wax in sufficient quantities to be of economic importance.

DESCRIPTIONS OF SPECIES

Subfamily DIASPINAE

Genus **ASPIDIOTUS** Bouché

This genus includes species of Diaspinae in which the scale of the female is circular or nearly so, with the exuviae at or near the center; and the scale of the male somewhat elongated, with the larval skin at one side of the center or near one extremity. The last segment of the female usually presents four groups of spinnerets; in a few species there are five groups, and in some they are wanting.

ASPIDIOTUS ANCYLUS Putnam

(Plate XIV, fig. 3; Plate XXI, fig. 2, 4)

Diaspis ancylus Putnam. Transactions of the Iowa State Horticultural Society for 1877, vol. xii, p. 321.
Aspidiotus ancylus Putnam. Proceedings of Davenport Academy, vol. ii, p. 346.

Scale of female.— The scale of the female is usually slightly wider than long, although nearly circular, with the exuviae laterad of the center, and covered with a thin layer of excretion. This film is white, but it is easily removed, leaving the brick-red exuviae exposed. That part of the scale immediately surrounding the exuviae is dark gray, almost black; the margin of the scale is light gray; the whole scale has a reddish tinge. It measures about 1.4 mm. in length and 1.3 mm. in width. Ventral scale white and very delicate.

Female.— The female is pale yellowish or pale orange in color, marked with translucent spots. The outline of the body before oviposition is ovate, but becomes more or less circular after the insect begins to oviposit. The last segment presents the following characters (Plate XIV, fig. 3):

There are four or five groups of *spinnerets*. The anterior group, when present, varies from a single spinneret to six, but it rarely consists of more than three; the anterior laterals vary from six to fourteen; the posterior laterals vary from five to eight.

Only one pair of *lobes* present, these are large; each is notched at about the middle of the lateral margin; occasionally there is a small notch near the end of the lobe on the mesal margin.

There are two *incisions* of the margin of the ventral surface on each side of the meson, one just laterad of the lobe, and one laterad of the second spine. The part of the body wall bounding these incisions is conspicuously thickened.

There are two *plates* caudad of each incision; these plates are usually simple, but are sometimes toothed; occasionally there is a third plate in one or more of these places. There are three to four irregular slender plates between the third and fourth pairs of spines. The first, second, and third pairs of spines are situated as in allied species; the fourth pair is at two-thirds the distance from the lobes to the penultimate segment. Described from five specimens from maple, two from peach, seven from osage orange, twelve from hackberry, fifteen from ash, and eleven from *Staphylea trifoliata.*

Variety.— A form of Aspidiotus was found, the scales of which I am unable to distinguish from those of *A. ancylus;* but the last segment of

the female presents the following difference from the typical form of this species: There are no plates between the third and fourth pairs of spines; and the vaginal opening is mesad the anterior spinnerets of the posterior lateral groups, instead of the posterior members of the same groups. The variation in the number of the spinnerets is greater in my specimens of the variety than in those of the typical form, there being in some cases seventeen on the anterior laterals, and nine on the posterior laterals. Described from twenty-one specimens from linden, eleven from beech, eighteen from oak, and four from water locust.

Scale of male.— The scale of the male resembles that of the female in color, but is smaller and more elongated. Length 1.2 mm., width 0.6 mm.

Male.— The male is easily distinguished from all other species known to us by the small size of its wings. We have bred numerous specimens from seven species of plants: maple, Staphylea, hackberry, ash, osage orange, peach, and water locust. These males show considerable variation, and for a time I believed that I had two species. The extreme forms are represented by figures 2 and 4, Plate XXI. In each the color of the body is orange yellow; in the former, which was bred from peach, the thoracic band is dark brown, and the distal joints of the antennae are not enlarged; in the latter, which was bred from ash, the thoracic band is of the same color as the remainder of the body, and the distal joints of the antennae are conspicuously enlarged. These two forms shade into each other, and each was bred from plants which were infested by the typical females only.

Habitat.— Davenport, Iowa (Putnam), Washington, and western New York.

ASPIDIOTUS AURANTII Maskell

THE RED SCALE OF CALIFORNIA

(Plate III, fig. 1; Plate XII, fig. 1; Plate XIII, fig. 1)

Aspidiotus aurantii Maskell. Trans. and Proc. of the New Zealand Institute, vol. xi, p. 199.

Aspidiotus citri Comstock. Canadian Entomologist, vol. xiii, p. 8.

Scale of female.— This scale resembles that of *Aspidiotus ficus* in shape, size, and the presence of the nipple-like prominence, which indicates the position of the first larval skin; but it can be readily distinguished from the scale of that species as follows: It is light gray, and quite translucent; its apparent color depending on the color of the insect beneath, and varying from a light greenish yellow to a bright reddish brown; the central third (that part which covers the second skin) is as dark and usually darker than the remainder of the scale; and when the female is fully grown the peculiar reniform body is discernible through the scale, causing the darker part of the outer two-thirds of the scale to appear as a broken ring. (Plate III, fig. 1*b*.)

Female.— The female is light yellow in color in the adolescent stages, becoming brownish as it reaches maturity. When fully developed the thorax extends backward in a large rounded lobe on each side, projecting beyond the extremity of the abdomen, and giving the body a reniform shape. The last abdominal segment presents the following characters (Plate XII, fig. 1):

I have been unable to detect the presence of the groups of *spinnerets*, although I have examined many specimens prepared in various ways.

There are three pairs of well-developed *lobes*. The lobes of the first pair are abruptly narrowed at about half their length; the notch on the

mesal margin is often nearer the distal end of the lobe than that of the lateral margin. The lobes of the second and third pairs are abruptly narrowed at half their length on the lateral margin, and often bear a notch on the median margin near the distal end. Laterad of the most lateral plate is a triangular lobe of the *margin of the segment,* which is serrate.

The *plates* are all deeply fringed; those between the first pair of lobes on their distal margins, the others on their lateral margins. They are all well developed, exceeding the lobes in length, and are situated as follows: Two between the first pair of lobes, two between the first and second lobes of each side, two between the second and third lobes, and three between the third lobe and the lobe of the margin of the body. The first plate laterad of the second lobe, and the three plates laterad of the third lobe are each deeply bifurcated, and each bifurcation is fringed on the lateral margin.

On the ventral surface there is a *spine* near the base of the lateral margin of each of the four lobes except the first; there are also about three small slender spines on the margin of the body near the penultimate segment. On the dorsal surface there is a spine with each lobe. The first spine is very slender and inconspicuous, but as long as the lobe; it is situated at the base of the lateral margin of the lobe in such a manner that it can be moved either above or below the lobe. Each of the other spines is situated near the middle of the base of the lobe it accompanies.

Egg.— I have not seen the eggs of this species, excepting those taken from the body of the female. And as I have repeatedly found young larvae under the scales I am led to believe that the species is viviparous.

Scale of male.— The scale of the male resembles that of the female, excepting that it is only one-fourth as large; the posterior side is prolonged into a flap, which is quite thin; and the part which covers the larval skin is often lighter than the remainder of the scale.

Male.— The male is light yellow, with the thoracic band brown, and the eyes purplish black. The outline drawing on Plate XIII, figure 1, represents the shape of the various organs.

Habitat.— I have observed this species in several groves at San Gabriel and Los Angeles, Cal. At the first-named place, where it is very abundant, it is said to have first appeared on a budded orange tree which was purchased by Mr. L. J. Rose, at one of the hothouses in San Francisco. At Los Angeles it appears to have spread from six lemon trees which were brought from Australia by Don Mateo Keller.

At first I considered this an undescribed species, as I could find no description of it either in American or European entomological publications. I therefore described it in the Canadian Entomologist under the name of *Aspidiotus citri.* Afterwards I obtained copies of the papers *On some Coccidae in New Zealand,* by W. M. Maskell, published in the Transactions and Proceedings of the New Zealand Institute, and found that he had described an insect infesting oranges and lemons imported into New Zealand from Sydney which was either identical with or very closely allied to the red scale of California. I at once sent to Mr. Maskell for specimens of the species described by him. These have just been received and prove to be specifically identical with those infesting citrus trees in California. Thus the question as to source from which we derived this pest is settled beyond a doubt.

I have found *Aspidiotus aurantii* only on citrus trees. It infests the

trunk, limbs, leaves, and fruit. The infested leaves turn yellow, and when badly infested they drop from the tree. This species spreads quite rapidly; and from what I have seen of it, I believe that it is more to be feared than any other scale insect infesting citrus fruits in this country. As illustrating the extent of its ravages in Australia, Dr. Bleasdale told me of a grove of thirty-three acres which nine years ago rented for £1800 per year, and for which three years ago only £120 rent could be obtained.

Specimens of this insect colonized on orange trees in the breeding room of the department passed through their entire existence in a little more than two months; hence it is probable that in the open air in southern California there are at least five generations each year, and possibly six. The mode of the formation of the scale in this species very closely resembles that of *A. ficus,* described at length in this report. The ventral scale, however, reaches a greater degree of development in *A. aurantii* than in *A. ficus.* At first it consists of a very delicate film upon the leaf; when the second molt occurs it is strengthened by the ventral half of the cast skin, the skin splitting about the margin of the insect, the dorsal half adhering to the dorsal scale and the ventral half to the ventral scale. Later, after the impregnation of the female, the ventral scale becomes firmly attached to the dorsal scale and to the insect; so that it is almost impossible to remove an adult female from her scale.

ASPIDIOTUS CONVEXUS, new species

THE CONVEX SCALE

(Plate XII, fig. 8)

This species, which is very common on the bark of the trunk and limbs of the native willows in California, very closely resembles *Aspidiotus rapax* in the shape and color of its scale. The resemblance of the two species is so great that at first I considered them identical, and concluded that *A. rapax* had spread to the cultivated trees in California from the native willows of that State. But a careful study of the structure of the two forms shows them to be specifically distinct. The most striking differences are those presented by the last abdominal segment of the female. In this species there are four groups of spinnerets; the superior laterals consisting of about seven, and the inferior laterals of about four. In *A. rapax* the groups of spinnerets are wanting.

In this species the plates are very much shorter than in *A. rapax,* and very closely resemble the plates in *A. ancylus.* But *A. convexus* differs greatly from *A. ancylus* in the shape and color of the scale and in the wings of the male being long. Described from seven females, two males, and very many scales.

ASPIDIOTUS CYDONIAE, new species

THE QUINCE SCALE

(Plate XIV, fig. 1)

Scale of female.— The scale of the female is indistinguishable from that of *Aspidiotus rapax,* described in this report.

Female.— The last segment of the body of the female presents the following characters:

There are four groups of *spinnerets*. The anterior laterals consist of eight or nine each, and the posterior laterals of from five to seven each.

There are only one pair of *lobes*, the median, visible; these are well developed. Each lobe is notched on each side; the notch on the mesal margin is slightly distad the one on the lateral margin.

The margin of the ventral surface of the segment is deeply *incised*, as in *A. rapax* and allied species, there being two incisions on each side of the meson.

The *plates* are of two kinds; the first is simple, tapering, and rather short; the second is toothed and long, extending caudad as far as the tips of the median lobes. Of the first kind, there are two between the median lobes, one on each side between the incisions, and from one to three laterad of the second incision. Of the second kind, there are on each side two caudad of the first incision, and three caudad of the second incision.

The *spines* of each surface are situated as follows: first, near the base of the lateral margin of the lobe; second, between the first and second incisions; third, laterad of second incisions; fourth, about midway between the third and the penultimate segment. Described from eighteen females.

Habitat.— Upon quince in Florida.

This species is very closely related to *A. rapax* and *A. convexus*. It is easily distinguished from the former by the presence of the groups of spinnerets, and from the latter by the number of incisions in the posterior margin of last segment of female, there being three pairs in *A. convexus*, and only two in *A. cydoniae*, and in the length and size of the plates. (Compare Plate XII, fig. 8, and Plate XIV, fig. 1.)

ASPIDIOTUS FICUS Riley MSS.

THE RED SCALE OF FLORIDA

(Plate III, fig. 2; Plate XII, fig. 2; Plate XIII, fig. 2; Plate XXI, fig. 3)

Chrysomphalus ficus Riley MSS. Ashmead, American Entomologist, 1880, p. 267.
Aspidiotus ficus Comstock, Canadian Entomologist, vol. xiii, p. 8.

Scale of female.— The scale of the female is circular, with the exuviae nearly central; the position of the first skin is indicated by a nipple-like prominence, which in fresh specimens is white, and is the remains of a mass of cottony excretion, beneath which the first skin is shed. The part of the scale covering the second skin is light reddish brown; the remainder of the scale is much darker, varying from a dark reddish brown to black, excepting the thin part of the margin, which is gray. When fully grown the scale measures 2 mm. (.08 inch) in diameter. In some specimens the part covering the exuviae is depressed, and when the scale is removed from the leaf and viewed under a microscope with transmitted light, the exuviae, which are bright yellow, show through this part, causing it to appear as described by Mr. Ashmead. This scale is represented on Plate III, figure 2; natural size, figure 2*a*, enlarged.

Female.— The body of the female is nearly circular; it is white, marked with irregular yellow spots. The last segment presents the following characters (Plate XII, fig. 2):

There are four *groups of spinnerets*; the anterior laterals consist each of about eight, and the posterior laterals of about four.

There are three pairs of well-developed *lobes.* The first and second lobes of each side are abruptly narrowed toward their posterior extremities on the lateral edges at about one-half their length; the third lobe is narrowed by a succession of notches on its lateral margin; all the lobes are widened slightly toward their bases on their mesal margins.

The *lateral margin* of the segment appears to be of the same structure as the lobes; it is serrate, deeply notched two or three times, and ends posteriorly in a lobe.

There are six *thickenings of the body wall* on each side of the meson. These are linear, oblong, with the anterior ends rounded and slightly expanded, and are more or less nearly parallel with the meson. One arising from the mesal margin of first lobe exceeds it a little in length; one from the lateral margin of the same lobe extends nearly to the anus; one each from the mesal margins of the second and third lobes are about twice the length of the lobes, and with the anterior extremities farther from the meson than the posterior; one from a point about midway between the second and third lobes extends anteriorly beyond any of the other thickenings; and finally one from the lateral margin of the third lobe is short, inconspicuous, and sometimes wanting.

Between the first pair of lobes are two wide oblong *plates,* with the distal margin of each deeply fringed; between the first and second lobes of each side are two, and between the second and third lobes are three similar plates; between the third lobe and the one at the end of the thickened lateral margin are three large compound plates, each consisting of two long branches, which are toothed deeply and irregularly on their lateral edges.

On the ventral surface near the margin of the segment are situated four pairs of *spines,* there being a spine at the base of the lateral margin of each lobe, including the lobe of the thickened margin of the segment described above. On the dorsal surface there are only three pairs of spines, none being present on the first pair of lobes; each spine is situated near the middle of the base of the lobe it accompanies.

Egg.— The eggs are pale yellow.

Scale of male.— The scale of the male is about one-fourth as large as that of the female; the posterior side is prolonged into a thin flap, which is gray in color; in other respects the scale appears like that of the female. (Plate III, fig. 2*b*.)

Male.— The male is light orange-yellow in color, with the thoracic band dark brown and the eyes purplish black. It very closely resembles the males of *A. aurantii,* but differs from that species in being a smaller insect, with shorter antennae, longer style, wider thoracic band, and with the pockets of the wings for the insertion of the hair of the poisers farther from the body.

Development of the insect and formation of the scale.—The development of this insect from the egg to the adult state was followed through five generations. I give, however, only the substance of a part of the notes taken on a single brood — the second one observed — as that will be sufficient for our purpose. The observations were made upon specimens which were colonized on small orange trees in pots in my office in Washington. The rate of the development of the insects was probably slower than would have been the case in the open air in Florida.

April 12, 1880, specimens of orange leaves infested by this scale were received from Mr. G. W. Holmes, Orlando, Fla. At this date males were found both in the pupa and adult state. The females also varied in size, and some of them were ovipositing. Eggs were placed on an orange tree for special study.

April 13, the eggs began to hatch. The newly hatched larva (Plate III, fig. 2*c*) is broadly oval in outline and yellow in color. The antennae are five-jointed; the three basal joints are very short and nearly equal in length; the fourth and fifth joints are each longer than the three basal joints together. The fifth joint is strongly tuberculated at tip so as to appear bifurcated. The eyes are prominent and of the same color as the body. The young larvae are quite active, but they settle soon after hatching. Some settled the same day that they hatched.

April 14, it was found that the young lice, although only twenty-four hours old, had formed scales which completely concealed them from sight. These scales resembled in appearance the fruiting organs of certain minute fungi. They were white, circular, convex, with a slightly depressed ring around the central portion (Plate III, fig. 2*d*); their texture was quite dense, and they were not firmly attached to either the insect or the leaf, a slight touch being sufficient to remove them without disturbing the larvae. The larvae had not changed in appearance, and were able to move their legs and antennae.

April 15, the lice had not changed perceptibly. The scales had become higher and more rounded.

April 16, the lice had contracted considerably, being now nearly circular, at least as broad as long; in other respects there was no apparent change. The scales were found to vary somewhat; those most advanced having the central portion covered with a loose mass of curled white threads (Plate III, fig. 2*e*).

April 17, there was apparent no further change in the larva; but the mass of threads covering the central part of the scale was found in some specimens to have greatly increased in size, equaling in height three or four times the width of the scale. This mass is cottony in appearance, and in those specimens where it is largest is more or less in the form of a plate twisted into a close spiral (Plate III, fig. 2*f*).

April 19, not much change was apparent in the larva, but the mass of cottony excretion upon some of the scales had increased enormously; so that in some cases it extended in a curve from the scale to a point five times the width of the scale above the leaf and down to the leaf.

April 20, no important change was observed either in the larvae or scales.

April 21, it was observed that the larvae had become more or less transparent, and marked with large irregular yellow spots near the lateral margin of the head and thorax, and with a transverse row of similar spots across the base of the abdomen; the tip of the abdomen is very faintly yellow.

April 22, no important change was noted.

April 23, it was observed that the scales appeared faintly reddish in color with the center white; the reddish color, however, was due in part to the body of the larva, which is now orange-red, showing through the scale. It should be noted that in only a part of the specimens did the cottony mass become enlarged as represented in figure 2*f*. The greater part of the scales remained until this date of the form shown in figure 2*e*, and the cottony spirals have now disappeared, probably having been blown away.

April 24, some of the larvae had become deep orange in color.

April 26, most of the scales had become deep orange in color with the central part white; some had at the center a small nipple-like protuberance; others still preserved a short tuft of a cottony excretion. This tuft is either removed by wind or otherwise, or it becomes compact, melted, as it were, to form the nipple-like projection referred to above.

April 28, the insects appeared as they did two days ago; the scales had become very tough, and it was with difficulty that they could be removed from the insect.

April 30, the insects still remained apparently unchanged. Some of the scales were only about one-half as large as others, and still remained perfectly white; these proved to be male scales. All the scales at this date had an elevated ring on the disk with a central nipple.

May 3, many of the larvae began to show that they were about to molt, the form of the next stage being visible through the skin of the insect.

May 5, nearly all of the larvae had molted; they were now orange-yellow, with the end of the body colorless. The last abdominal segment now presents the excretory pores which are represented in the drawing of the corresponding segment of the adult female (Plate XII, fig. 2). The molted skin adheres to the inside of the little scale, and therefore cannot be seen from the outside. The scales are now pink, or rose-colored, with the center white.

May 14, the insects had become a somewhat paler yellow, with the anal segment slightly darker. Most of the scales were now dark purple. On removing an insect a very delicate round white plate was observed adhering to the leaf where the mouth parts were inserted.

May 18, the male scales were fully grown. At this stage they were dark reddish brown in color, with the center white, and the posterior side, which is elongated, gray. At this date some of the males had transformed to pupae; others were still in the larva state; these larvae were covered with roundish, more or less confluent yellow spots, leaving only the margin colorless; the end of the body was pale orange. The newly transformed pupae resembled in markings the larvae just described. None of the females had yet molted the second time; their color was deep orange.

May 21, nearly all of the males had changed to pupae. It was observed that the last larval skin is pushed backwards from under the scale, to the edge of which it frequently adheres.

May 24, none of the male pupae had transformed to the adult state.

May 29, it was found that during the five days previous more than one-half of the males had issued, and the remainder, though still under the scales, were in the adult state. It was now forty-seven days from the time the larvae hatched.

June 2, no males could be found; the females were about one-half grown, and were whitish with irregular yellow spots.

June 9, eggs were observed within the body of a female.

June 17, it was found that one of the females had deposited nine eggs, of which six had hatched. This is sixty-six days from the hatching of the egg, and probably about twenty days after impregnation of the female.

The insects of this brood continued to oviposit until July 1.

Number of generations per year.— This insect, living on orange trees in a room on the north side of a building in Washington, passed through five generations in less than one year; the average time occupied by a single generation was a little less than seventy days. It is probable that in the open air in Orange County, Florida, there are at least six generations each year.

Habitat.— Although I have carefully explored many orange groves in Florida and California, and have had an extensive correspondence with orange growers, I have been unable to find this species in the last-named State, and have found it only in a single grove in Florida. This

is the grove of Messrs. Holmes and Robinson, near Orlando, in Orange County. The insects were first observed here in the spring of 1879 on a sour-orange tree which was brought from Havana, Cuba, in 1874. On learning these facts I sent specimens to a friend at Havana in order to ascertain if the species occurred there. He at once returned me other specimens with the information that it is a very common pest in public gardens of that city.

This species infests the limbs, leaves, and fruit indiscriminately. In the grove of Messrs. Holmes and Robinson it has spread slowly. The large trees which are infested do not seem to suffer much from it, but the young trees are greatly injured by it. Mr. Holmes considers the disfiguring of the fruit as the worst feature of the pest. The insect has multiplied to such an extent upon the trees upon which I colonized it in my breeding-room, that nearly all of them have been destroyed. The species is certainly one that is greatly to be feared, and there is no doubt that it would be a good investment for the orange growers of Florida to eradicate the pest, even if in doing so it is found necessary to purchase and destroy all infested trees. This could be done now easily, but if delayed a few years the species will doubtless become permanently established.

ASPIDIOTUS JUGLANS-REGIAE, new species

THE ENGLISH WALNUT SCALE

(Plate XIV, fig. 2)

Scale of the female.— The scale of the female is circular, flat, with the exuviae laterad of the center; it is of a pale grayish brown color; the exuviae are covered with secretion; the position of the first skin is indicated by a prominence which is pink or reddish brown. The ventral scale is a mere film which adheres to the bark. Diameter of scale, 3 mm. (.13 inch).

Female.— The color of the female when fully grown is pale yellow with irregular orange-colored spots; oral setae and last segment dark yellow. This segment presents the following characters:

There are either four or five groups of *spinnerets*; the anterior group is wanting or consists of from one to four spinnerets, the anterior laterals consist of from seven to sixteen, and the posterior laterals of from four to eight.

There are two or three pairs of *lobes*. The median lobes are well developed, but vary in outline; the second lobe of each side is less than one-half as large as the median lobes, elongated, and with one or two notches on the lateral margin; the third lobe is still smaller and pointed, or is obsolete.

There are two pairs of *incisions* of the margin, one between the first and second lobes of each side, and one between the second and third lobes; they are small, but are rendered conspicuous by the thickenings of the body wall bounding them.

The *plates* are simple, inconspicuous, and resemble the spines in form. The larger ones are situated one caudad of each incision.

The *spines* are prominent, especially those laterad of the second and third lobes; the fourth spines are a little nearer the first lobes than the penultimate segment; and the fifth are near the penultimate segment; there is also a spine at or near the union of the last two segments.

Scale of male.— The scale of the male resembles that of the female in

color; it is elongated, with the larval skin near the anterior end; this skin is covered by excretion, but its position is marked by a rose-colored prominence, as in the scale of the female; the anterior part of the scale is much more convex than the posterior prolongation, which is flattened. There is a rudimentary ventral scale in the form of two narrow longitudinal plates, one on each side of the lower surface of the scale. Length, 1.25 mm. (.05 inch).

Male.— Only dead males have been found; these were too much shriveled to be of use for description.

Habitat.— On the bark of the larger limbs of English walnut (*Juglans regia*), at Los Angeles, Cal. Described from sixty-three females, and many scales of each sex.

My attention was called to this interesting species by Mr. J. W. Wolfkill, of Los Angeles, who rendered me valuable assistance in my investigations in that locality.

There are in the collection of the department specimens of Aspidiotus from locust, pear, and cherry, from New York and District of Columbia, which apparently belong to this species.

ASPIDIOTUS NERII Bouché

Aspidiotus nerii Bouché, Schädl. Gart. Ins. (1833), 52.
Diaspis bouchéi Targioni-Tozzetti (1867), Stud. sul. Coccin.

(Plate IV, fig. 1; Plate XV, fig. 1)

Scale of the female.— The scale of the female is flat, whitish, or light gray in color, and with the exuviae central or nearly so (Fig. —). Exuviae dull orange-yellow; the first skin usually showing the segmentation distinctly, the second skin more or less covered with secretion, often appearing only as an orange-colored circle surrounding the first skin. Ventral scale a mere film applied to bark of plant. Diameter of fully formed scale, 2 mm. (.08 inch).

Female.— The body of the adult female is nearly circular in outline, with the abdominal segments forming a pointed projection; light yellow in color, mottled with darker yellow; the last segment presents the following characters:

The anterior lateral groups of *spinnerets* consist each of about nine, and the posterior laterals of about seven.

There are three pairs of *lobes*; the first and second are well developed, the third are quite small.

The *plates* are well developed; they are long and usually fringed; there are two small ones between the median lobes; those of each side are as follows: two between the first and second lobes; three between second and third lobes; and usually seven laterad of the third lobe, of which usually four are fringed and three simple. The number of the last-named group varies from four to nine.

There is on each surface of the segment a *spine* accompanying each lobe; one between the fourth and fifth plates laterad of third lobe, and one at about one-third the distance from this spine to the penultimate segment. In each case the spine on the ventral surface is a little laterad of the one on the dorsal surface.

Egg.— The eggs are very light yellow in color.

Scale of male.— The scale of the male is slightly elongated, with the larval skin nearly central; it is snowy white with the larval skin light yellow; longest diameter, 1 mm. (.04 inch). (Fig. 1*f*.)

Male.— The adult male is yellow mottled with reddish brown, central part of thoracic band reddish. Other characters represented in figure 1*a*.

Habitat.— This is a very common European species which infests many different plants, and it is spread throughout our country from Atlantic to the Pacific, and from the Great Lakes to the Gulf of Mexico. I have found it more abundant on acacias in California than elsewhere, and for a time believed that it had been introduced from Australia with this tree. Many trees were found the leaves of which were completely covered with the scales, appearing as if they had been coated with whitewash. Leaves of magnolia were received from Mr. C. H. Dwinelle, Berkeley, Cal., which were infested to a similar extent. The following is a list of the plants upon which I have studied this species: acacia, magnolia, oleander, maple, yucca, plum, cherry, currant, and Melia (*Melia azederach*) in California; oleander in Utah; English ivy in a conservatory at Ithaca, N. Y.; ivy and "China tree" from Dr. R. S. Turner, Fort George, Fla.; grass and clover growing in pots with orange trees upon which I was rearing the scale at this department; lemons imported from the Mediterranean by a San Francisco dealer; and lemons forwarded to me by Mr. Alex. Craw from the grove of Mr. Wolfkill, at Los Angeles, Cal.

The scales upon magnolia from Berkeley, Cal., and upon oleander from Salt Lake City appear somewhat different from those on acacia and other plants. But after a very careful study of the different forms from each plant, I am unable to point out any character which will distinguish those on magnolia and oleander from others.

Specimens of infested lemons from Europe were forwarded to me at Washington by the editor of the Riverside Press and Horticulturist, who had received them from a correspondent in San Francisco, who had imported them from the Mediterranean. Notwithstanding the great distance (once across the Atlantic and twice across the continent) which this fruit had been transported, the insects infesting it were alive and in a healthy condition. This illustrates the ease with which these insects may spread from one country to another, and the dangers attending the introduction of foreign fruit and nursery stock.

The appearance of this pest upon citrus fruits in southern California is greatly to be regretted, for the species is already so common on other plants that it may be difficult to keep the orange groves free from it. The fact, however, that it infests acacia, oleander, and other plants to such a great extent, and has been observed but few times in this country on citrus fruits, may be taken as an indication that it is not liable to multiply to any great extent upon oranges and lemons.

In the specimens which I have seen the leaves of the lemon were not infested, but the scales were very abundant on the fruit.

The young of this insect which were found on ivy in Florida were colonized on an orange tree in the breeding room of the department. When one day old the larvae had settled and commenced excreting a covering; when four days old this covering was quite dense; on the twentieth day some larvae molted, and on the twenty-eighth day the second molt occurred. It was observed that this molt was accomplished by a splitting of the skin at the sides of the body, so that the dorsal half of the skin became attached to the scale and the ventral half to the leaf. Soon after this molt all the specimens died. This was an indication that this species could not mature upon the orange. But a very careful study of the form from Florida has failed to reveal any character by which it can be separated from that living on lemon in California.

Although I failed to ascertain the time occupied by a single genera-

tion, the following notes indicate that there are at least two each year, and probably more. On the 13th of April, 1880, specimens of magnolia leaves were received from Berkeley, Cal., infested by this insect. The eggs were hatching from this date till 27th April. During this time (22d April) leaves of ivy were received from Florida, upon which were scales and newly hatched young of this species. On the 21st of May other specimens were received from Florida; of these the females were about one-half grown, and the males were in the pupa state.

On the 24th of August I observed again at Los Angeles, Cal., the eggs of this species.

During April adult males emerged in my breeding-cages from both the California (Berkeley) and Florida specimens. And during August the males were again flying at Los Angeles, Cal.

In conservatories there is apparently no regularity in the periods of this insect; for specimens of all stages, from the egg to the adult, may be observed at the same time.

ASPIDIOTUS OBSCURUS, new species

THE OBSCURE SCALE

(Plate XII, fig. 4; Plate XIII, fig. 4)

Scale of female.— The scale of the female is very dark gray, agreeing in color with the bark to which it is attached; and as it is only slightly convex, its presence is difficult to detect. It is somewhat irregular in outline, but nearly circular. The exuviae are between the center and one side; their position is indicated by a nipple-like prominence, which is marked, as in many other species, with a white dot and concentric ring of the same color. The ventral scale consists of a delicate film of white excretion, and the lower half of the exuviae attached to the bark. Diameter of scale, 3 mm. (.12 inch).

Female.— The body of the fully grown female is reniform, being only four-fifths as long as wide, and having the lobes of the penultimate segment extending back nearly as far as the end of the body. The segmentation of the body is very indistinct; the color is a yellowish brown. The last segment presents the following characters (Plate XII, fig. 4):

There are five groups of *spinnerets*; the median consists of about six, the superior lateral of about twelve, and the inferior lateral of about eight. The oval pores opening on the dorsal side of the body are to be seen very distinctly from below.

There are three pairs of well-developed *lobes*. The first lobe of each side is conical, tapering anteriorly, and with the distal margin rounded; there is often a small notch on the lateral side. The distal margins of the second and third lobes are serrate.

The thickened part of the *lateral margin* of the segment becomes narrower anteriorly until near the penultimate segment it is a mere line. It is irregularly notched and is terminated posteriorly by a prominent lobe.

There are seven short club-shaped *thickenings* of the body wall upon each side of the meson. Each thickening is rounded anteriorly and tapers posteriorly. They are situated as follows: one terminating near the lateral margin of the first lobe, one at each side of second lobe, one midway between second and third lobes, one at each side of third lobe, and one near the posterior end of the thickened lateral margin. This one is often obsolete. Those terminating at the median sides of the sec-

ond and third lobes are narrower and shorter, and have their anterior ends directed laterad more than the others. The remaining thickenings are of about the same length as the median lobes.

The *plates* are inconspicuous, and in no case extend as far as the lobes. There is one between the median lobes, one between the first and second lobe of each side, two between the second and third lobes, and two between the third lobe and the posterior end of the thickened lateral margin. The last two are unequally bifid, the other four are simple and truncate.

On the ventral side the first pair of *spines* is obsolete, the second and third pores are situated at the base of the lateral margins of their respective lobes, the fourth pair is just laterad of the lobe of the lateral margin, and a fifth pair is situated about one-third the distance from this lobe to the penultimate segment. On the dorsal side the first pair is also obsolete, each member of the other four pairs is situated in little mesad of the corresponding spine on the ventral surface.

Egg.— The eggs have not been observed, and several specimens of females in the collection indicate that the species is viviparous.

Scale of male.— The scale of the male is oval in outline with the protuberance covering the larval skin near the anterior end. This scale is of the same color as that of the female.

Length, a little more than 1 mm. (.04 inch); breadth nearly ½ mm. (.02 inch).

Habitat.— On the bark of the limbs of willow oak (*Quercus phellos*) at Washington, D. C.

Described from forty females, and very many scales of each sex.

The scale of this species resembles very much that of *Aspidiotus tenebricosus*, which occurs on red maple. That scale, however, is much more convex than this one, and its diameter is only one-half as great.

ASPIDIOTUS PERNICIOSUS, new species

THE PERNICIOUS SCALE

(Plate XII, fig. 7)

Scale of female.— The scale of the female is circular and flat, with the exuviae central, or nearly so. The scale is gray, excepting the central part, that which covers the exuviae, which varies from a pale yellow to a reddish yellow; sometimes the central part is black, resembling the scale of the male, and in some specimens the outer part of the scale is marked by radiating ridges. Diameter, 2 mm. (.08 inch).

Female.— The body of the female is yellowish and almost circular in outline; the segmentation is distinct, though not conspicuous. The last segment presents the following characters:

There are only two pairs of *lobes* visible; the first pair converge at tip, are notched about midway their length on the lateral margin, and often bear a slight notch on the mesal margin near the tip. The second pair are notched once on the lateral margin.

The margin of the ventral surface of the segment is deeply *incised* twice on each side of the meson; once between the bases of the first and second lobes and again laterad of the second lobe. On each side of each of these incisions is a club-shaped thickening of the body wall.

There are two inconspicuous simple *plates* between the median lobes, and on each side two similar plates extending caudad of the first incision, three small plates serrate on their lateral margin caudad of the second incision, and the club-shaped thickenings of the body wall

bounding it, and three wide prolongations of the margin between the third and fourth spines. These prolongations are usually fringed on their distal margin. There are also in some, irregular prolongations of the margin between the fourth spine and the penultimate segment.

The first and second *spines* are situated laterad of the first and second lobes, respectively; the third spine laterad of second incision; and the fourth spine about half the distance from the first lobe to the penultimate segment.

Egg.— The eggs are white.

Scale of male.— The scale of the male is black, and is somewhat elongated when fully formed. The larval skin is covered with secretion; its position is marked by a nipple-like prominence which is between the center and the anterior margin of the scale. The scale of the male is more abundant than that of the female.

Male.— The male has not yet been observed.

Habitat.— On apple, pear, plum, and other trees in Santa Clara County, California.

Described from thirty females, and very many scales of each sex.

I regret that as yet I have been able to study this very important pest but little. From what I have seen of it, I think that it is the most pernicious scale insect known in this country; certainly I never saw another species so abundant as this is in certain orchards which I have visited. It is said to infest all the deciduous fruits grown in California, excepting peach, apricot, and the black tartarean cherry. It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable. In other instances I have seen the bark of all of the small limbs completely covered by the scales. In such cases the wood beneath the bark is stained red.

This species is easily destroyed by strong alkaline washes, as is shown by the results of experiments given in the chapter on remedies.

ASPIDIOTUS PERSEAE, new species

THE RED BAY SCALE

(Plate XII, fig. 3; Plate XIII, fig. 3)

Scale of female.— The scale of the female is circular, flat, with the exuviae nearly central and covered with secretion. The outer part of the scale is dark reddish brown; that part covering the exuviae varies from a very dark gray to black. The ventral scale is a very delicate film which adheres to the leaf. The scale of this species closely resembles that of *Aspidiotus ficus* in form in the presence of the nipple-like prominence which indicates the position of the first skin, and in the color of the outer part of the scale. It is, however, smaller, and has the central part darker than the remainder of the scale, instead of lighter as with *A. ficus*. Diameter, 1.5 to 2 mm. (.06 to .08 inch).

Female.— The color of the female is orange. The body is nearly as wide as long. The last segment presents the following characters (Plate XII, fig. 3):

There are four groups of *spinnerets*; the anterior laterals consist of from ten to twelve, and the posterior laterals of about eight.

There are three pairs of well-developed *lobes* present; each lobe is wider than long; the first lobe of each side is the smallest, the third the largest; the second is usually notched; the third is serrate.

The posterior half of the *lateral margin of the segment* appears to be of the same structure as the lobes; it is serrate, and usually more or less deeply notched four or five times.

The body wall is furnished with seven *thickenings* on each side of the meson. These thickenings are long, somewhat club-shaped, the anterior part being enlarged and rounded. There is one terminating at the base of each margin of each lobe. Those ending at the base of the lateral margins of the lobes are much longer than the others. The seventh thickening terminates between the second and third lobes, and is narrow and inconspicuous.

The *plates* are small, inconspicuous, and irregularly toothed. There are two between each pair of lobes and between the third lobe of each side and the posterior lobe of the thickened lateral margin. The plates increase in size from the meson laterad.

On the ventral side there are four pairs of *spines,* there being a spine at the base of the lateral margin of each lobe and one at the anterior end of the thickened part of the lateral margin of the segment. On the dorsal side there are only three pairs of spines, there being none on the first lobes. Those of the second and third lobes are situated near the middle of the bases of the lobes; the third spine is nearly opposite the fourth spine of the ventral surface.

Egg.— The eggs are slender and pointed at one extremity.

Habitat.— Cedar Keys, Fla., on the leaves of red bay (*Persea carolinensis*).

I collected the scales during February, at which time eggs were found under some of them; a male pupa was also observed at that time.

ASPIDIOTUS? PINI, new species

(Plate XV, fig. 2; Plate XVI, fig. 2; Plate XXI, fig. 7)

Scale of female.— The scale of the female is much elongated, with its sides parallel and ends rounded. The exuviae are nearly central, and are covered with secretion. The color of the scale is dark gray, often approaching black, with the margin lighter, and sometimes with a bluish, brownish, or purplish tinge. In many specimens of the fully formed scale the part covering the exuviae is more or less distinct, appearing like a small scale with a light margin superimposed upon a larger scale. Length of scale, 2 to 3 mm. (.08 to .12 inch); width, .4 to 1 mm.

Female.— The last segment of the female presents the following characters (Plate XV, fig. 2, and Plate XVI, fig. 2):

The *spinnerets* are more or less elongated, and are arranged in two groups, which occupy the position of the anterior laterals in other species. Each group consists of from eleven to sixteen spinnerets.

The *lobes* are quite small; the first and second of each side are abruptly narrowed near the distal extremity; the third lobe is notched once or twice. About one-third of the distance from the third lobe to the penultimate segment is a lobe of the lateral margin of the body of about the size of the third lobe.

The *plates* are short and irregular; there are two with distal extremities fringed between the median lobes; two similar to these between first and second lobe of each side; the lateral member of this pair of plates is much wider than the mesal one; between the second and third lobes are usually four plates each with its lateral margin fringed; between the third lobe and the lobe on the lateral margin of the segment are four or five plates similar in form to those between the second and third lobes; two of these plates are usually very small. The segment is narrowed caudad by a succession of notches as shown in figure 2.

The *spines* of the dorsal surface are quite large; there is one laterad of first lobe; one upon the center of each of the second and third lobes, and one upon the lobe of the lateral margin of the body. On the ventral surface the first spine is obsolete; the second, third, and fourth are each laterad of corresponding spines on dorsal surface; of these the second spine is small, the others large.

Scale of male.— The scale of the male resembles very much the central part of the scale of the female; it is somewhat narrower and darker, being almost black, and with a greenish tinge. The larval skin is cephalad of the center of the scale, and is brownish yellow.

Male.— The body of the male is orange yellow; thoracic band brown; eyes dark brown; antennae (excepting basal joint, which is of the same color as body), legs, and stylet dusky (Plate XXI, fig. 7).

Habitat.— Very abundant on the leaves of pitch pine (*Pinus rigida*) at Ithaca, N. Y. I also collected it on the leaves of yellow pine (*Pinus mitis*) at Macon, Ga.

This species differs greatly from all species of Aspidiotus known to me, not only in the characters of the last segment of the female as shown in figure 2, but in the development of the body of the female, as I hope to show at some future time.

ASPIDIOTUS RAPAX, new species

THE GREEDY SCALE INSECT

(Plate XII, fig. 6)

Scale of female.— The scale of the female is very convex, with the exuviae between the center and one side, and covered with secretion. The scale is gray, somewhat transparent, so that it appears yellowish when it covers a living female; the prominence which covers the exuviae is dark brown or black, usually with a central dot and concentric ring which are white. Ventral scale snowy white, usually entire. Diameter 1½ mm. (.06 inch).

Female.— The body of the female is nearly circular in outline, bright yellow in color with more or less translucent blotches. The last segment presents the following characters:

The groups of *spinnerets* are wanting.

Only one pair of well-developed *lobes*, the median, present. These are prominent. Each one is furnished with a notch on each side; the notch on the mesal margin is distad of that on the lateral margin. The second and third pairs of lobes are represented by the minute pointed projections of the margin of the body.

The margin of the ventral surface of the segment is deeply *incised* twice on each side of the meson; once laterad of the first lobe, and again between the rudimentary second and third lobes. The parts of the body wall forming the margin of these incisions are conspicuously thickened.

There are two simple tapering *plates* between the median lobes, two deeply and irregularly toothed or branched plates extending caudad of each incision, one usually simple and tapering plate between the incisions of each side, and two or three of the same character laterad of the second incision.

The first, second, and third pairs of *spines* of each surface are situated near the lateral bases of the first, second, and third lobes respectively; the fourth pair are situated at a little more than one-half the distance from the median lobes to the penultimate segment. In each case the

spine on the ventral surface is but little laterad of the one on the dorsal surface.

Egg.— The eggs and newly hatched larvae are yellow.

Male.— Only dead and shriveled males have been observed.

Habitat.— On the bark of the trunk and limbs as well as the leaves and fruit of various trees and shrubs in California and Florida.

Described from seventy-five females and very many scales.

I have named this the greedy scale insect on account of the great number of plants upon which the species subsists. It also occurs in some localities in great numbers, being very destructive. This is especially the case on *Euonymus japonicus* at Fort George, Fla.; and in California on olive near San Buenaventura, and on mountain laurel (*Umbellularia californica*) at San José. I have also found it on the following-named plants in California: almond, quince, fig, willow, eucalyptus, acacia, and locust.

Mr. Elwood Cooper, of Santa Barbara, Cal., who has had some experience with this pest upon his olive trees, says that it is easily kept in check. According to his observations it flourished only upon those trees which are in an unhealthy condition, and as it is chiefly confined to the trunk and limbs it can be removed with a stiff brush and whale-oil soap solution.

ASPIDIOTUS TENEBRICOSUS, new species

THE GLOOMY SCALE

(Plate XII, fig. 5; Plate XIII, fig. 5)

Scale of female.— The scale of the female is very dark gray, agreeing in color with the bark to which it is attached; the protuberance indicating the position of the exuviae is marked with a white dot and concentric ring; in rubbed specimens this protuberance is smooth and black, in all cases the remainder of the surface of the scale is rough. The scale is very convex; the exuviae are usually between the center and one side. The ventral scale is well developed, especially at the margin, where it is much thickened and is dark-colored; the central part is white and adheres to the bark; while the thickened margin is easily removed as a ring. Diameter of scale, 1.5 mm. (.06 inch).

Female.— The female is nearly circular, being but slightly longer than broad; and is of a yellowish brown color. The segmentation of the body is not very distinct. The last segment presents the following characters:

Although forty-three specimens were carefully examined, no *groups of spinnerets* were found.

There are three pairs of well-developed *lobes*. The median lobes are rounded posteriorly, or often with a slight notch on the lateral margin, and taper to a point anteriorly; the second lobe of each side is somewhat triangular in outline, with the lateral edge serrate; the third lobe is larger than either the first or second lobes, triangular in outline, and serrate on lateral margin.

The posterior third of the *lateral margin of the segment* appears to be of the same structure as the lobes, and has five triangular serrate lobes; the posterior one of these is the largest, and is larger than either of the true lobes.

There are seven club-shaped *thickenings* of the body wall upon each side of the meson, which are arranged as follows: One terminating near the lateral margin of the first lobe; this extends anteriorly but a short

distance beyond the lobe. One appearing to be a prolongation of the mesal margin of the second lobe; this extends anteriorly to a point laterad with the anus. One terminating between the second and third lobes; this is linear, inconspicuous, and sometimes obsolete. One terminating at the base of the plates between the second and third lobes, and also one terminating at the base of the plates between the third lobe and the thickened lateral margin; these two are the largest, and extend anteriorly the farthest of all the thickenings. One terminating at the mesal margin of the third lobe, and one at the mesal end of the thickened lateral margin of the segment.

The *plates* between the median lobes and between the first and second lobes of each side are very small and often obsolete; there are two small, irregularly branched plates between the second spine and the third lobe, and also two similar plates between the third spine and the mesal end of the thickened lateral margin.

There are five pairs of *spines* on the ventral surface of the segment, and six on the dorsal. Those at the base of the median lobes are very small; the others are conspicuous. The second and third spines of each surface are situated just laterad of the second and third lobes respectively; in each case the dorsal spine is slightly mesad of that on the ventral surface. The fourth spine of the ventral surface is on the penultimate lobe of the thickened lateral margin. The fifth spine of this surface is near the anterior end of the thickened part of that margin. The fourth and fifth spines of the dorsal surface are in each case mesad of the corresponding spines of the ventral surface. There is also a spine on the dorsal side, very near the penultimate segment.

Egg.— The eggs have not been observed.

Scale of male.— The scale of the male is oval in outline, and of the same color as that of the female; the protuberance covering the larval skin is near the anterior end. The ventral scale is similar to that of the female, except that the margin is not so much thickened.

Male.— Only dead and shriveled males have been observed.

Habitat.— On the bark of the trunk and limbs of red or swamp maple (*Acer rubrum*) at Washington, D. C.

Described from forty-three females, and many scales of each sex.

ASPIDIOTUS UVAE, new species

THE GRAPE SCALE

(Plate XIV, fig. 4; Plate XVI, fig. 1)

Scale of female.— The scale of the female is flat, nearly circular, with the exuviae covered and more or less upon one side. The color of the scale is light yellowish brown, being a little lighter than the dry bark of the vine. The part of the scale covering the exuviae is white, the latter are bright yellow. The ventral scale is thin, white, contains the ventral half of the molted skins, and adheres to the bark; so that when the insect is removed its former position is indicated by a conspicuous white spot. Diameter of scale, 1.6 mm.

Female.— The body of the female is nearly circular, white, with a faint yellowish tinge, and with the margin colorless and more or less transparent. The last abdominal segment presents the following characters (Plate XIV, fig. 4):

There are either four or five *spinnerets*; the anterior group being either present or absent. Nineteen specimens were examined; the anterior group was represented by a single spinneret in three, by two

spinnerets in six, and was wanting in ten. The anterior laterals each consist of from four to nine spinnerets, and the posterior laterals of from three to eight.

Only one pair of *lobes* present; these are prominent, parallel with each other, or nearly so, and abruptly narrowed posteriorly; the mesal constriction is a little distad of the lateral one.

There are two *incisions* of the margin of the ventral surface on each side of the meson, one laterad of the first spine, the other laterad of the second spine. The body wall bounding these incisions is conspicuously thickened.

Caudad of each incision are two *plates,* which are long and serrate on the lateral margin. Between the third and fourth spine of each side are from three to five plates; these are usually simple and equal the spines in length.

There are four pairs of *spines* on the ventral side and three on the dorsal, the first dorsal pair being obsolete. The fourth pairs are about midway between the lobes and penultimate segment.

Scale of male.— The color of the scale of the male is slightly darker than that of the scale of the female; it is elongated, with the exuviae covered, and near one extremity. The layer of excretion covering the exuviae is white. Length of scale, .8 mm.; width, .4 mm.

Habitat.— On grapevines at Vevay, Ind., received from Charles G. Boerner.

This species infests the lower part of the grapevines, from the ground to the shoots of second year's growth. It can doubtless be easily destroyed by washing the vine with a strong solution of soap, using for this purpose a sponge.

Signoret describes* under the name of *Aspidiotus vitis* a species which infests grapes, and which, judging from his description, is very closely allied to this. It differs, however, from *A. uvae* in that the exuviae when they have been rubbed are of a brilliant black; and the last segment of the female does not present the usual groups of pores.

Genus **DIASPIS** Costa

This genus includes species of Diaspinae in which the scale of the female is more or less rounded, with the exuviae at the center or upon the side, and the scale of the male long, white, carinated, and with the larval skin at one extremity. The last segment of the female presents five groups of spinnerets.

This genus closely resembles Aspidiotus in the form of the scale of the female, but it is easily distinguished from that genus by the form of the scale of the male.

DIASPIS CARUELI Targ.-Tozz.

THE JUNIPER SCALE

(Plate V, fig. 2; Plate XV, fig. 3; Plate XXI, fig. 6)

Diaspis carueli Targioni-Tozzetti, Catal. (1868).

Scale of female.— The scale of the female is circular, snowy white, with the exuviae central or nearly so, naked, and yellow. Diameter of scale, 1 to 1.5 mm. (.04 to .06 inch). (Plate V, fig. 2*a*.)

*Annales de la Société Ent. de France, 1876, p. 603.

Female.— The females are yellow, circular in outline, a little elongated posteriorly. The last segment of the body presents the following characters:

The anterior group of *spinnerets* consists of about eight, the anterior laterals of from ten to sixteen, and the posterior laterals of about eight.

There are four *lobes* which are nearly in a straight line, the end of the body being truncate. These lobes are quite small, rounded posteriorly, and are equidistant from each other. The second lobe of each side is deeply incised, but the lateral lobule is very small and in many cases concealed by the margin of the segment.

Each *lateral margin* of the segment is divided into three subequal, more or less distinct lobes; each lobe ends posteriorly in one or two lobules, each of which bears an elongated pore on its dorsal surface.

The *plates* are short and in some cases subtruncate at extremities; they are situated as follows: two between median lobes; two inconspicuous ones lateral of first lobe of each side; two lateral of second lobe; usually one on the anterior part of the first lobe of the lateral margin; one or two near the middle of the second lobe of the lateral margin, and two or three on the third or anterior lobe of the lateral margin.

The *spines* on the dorsal surface are situated as follows: one upon the first lobe near its lateral margin; one on lateral lobule of the second lobe; and one a short distance mesad of the mesal plate of each of the three lobes of the lateral margin. On the ventral surface the spine accompanying the first and second lobes of each side are obsolete. There is one at the base of the plate of the first lobe of the lateral margin; one between the plates of the second lobe, and one near the middle of the third or anterior lobe of the lateral margin.

Scale of male.— The male scale is white and very small, being only 1 mm. (.04 inch) in length; it is elongated, with a prominent median ridge; the larval skin is naked and light yellow in color. (Fig. 2*b*.)

Male.— The color of the body is light orange yellow, with the thoracic band of the same color. The terminal joints of the antennae are enlarged. (For other characters, see Plate XXI, fig. 6.)

Habitat.— This species is very common in Washington, where we have found it infesting the following-named species of juniper and arbor vitae: *Juniperus chinensis, J. rigida, J. oxycedrus, J. japonica, J. communis, J. Reresii, Biota orientalis,* and *Thuya occidentalis.* It was collected by Professor Targioni-Tozzetti near Florence, Italy.

DIASPIS OSTREAEFORMIS (Curtis)

THE PEAR-TREE OYSTER SCALE

(Plate XV, fig. 4)

Aspidiotus ostreaeformis Ruricola, Gardeners' Chronicle, 1843, p. 803.
Aspidiotus circularis Fitch, Annual Report N. Y. State Agr. Soc., 1856, p. 426.

Scale of female.— The scale of the female is circular or broadly oval; it is of a dark ashy gray color, with the margin lighter; sometimes the scales are nearly white. The exuviae are central or nearly so, dark brown, usually naked and glossy. Diameter 1 to 1.4 mm. (.04 to .056 inch).

Female.— The body of the female is rounded, cordate when young; the last segment presents the following characters:

The anterior group of *spinnerets* consists of eight to twelve; the anterior laterals of twelve to thirteen; posterior laterals of eight to fourteen.

The median *lobes* are large and connate, about half their length; each lobe is rounded at its distal extremity, and widened anteriorly, sometimes abruptly. On each side of the median lobes are three slight incisions in the margin of the body, approximately equidistant from each other; the margins of these incisions are thickened, and mesad of each incision there is a rudimentary lobe; there is also usually a fifth rudimentary lobe between the fifth and sixth plates.

All the *plates* excepting the first pair are well developed, thick at the base, simple, tapering, and situated at nearly equal distances throughout the entire free margin of the segment. Laterad of first lobe is a short inconspicuous plate, between which and second lobe is a prolongation of the body wall bearing an elongated pore; second plate between second and third lobes, third plate between third and fourth lobes; between fourth and fifth lobes are two plates; laterad of fifth lobe are three plates, sometimes there is a fourth next to the penultimate segment. On the penultimate segment are three or four plates, and on the antepenultimate, one or two.

The *spines* on the dorsal surface are situated as follows: on each side a short one near the meson on first lobe; a long and conspicuous one laterad of same lobe; third and fourth caudad of first and second incisions; fifth laterad of third incision; and the sixth between the sixth and seventh plates. On the ventral surface the spines are smaller; first and second are obsolete, the third and fourth are laterad of the second and third incisions; and the fifth between the fourth and fifth plates.

Scale of male.— The male scales are of an elongated oval form and much flattened, especially the posterior half; a feeble carina extends along the middle, but the sides are not carinated; the larval skin is of a light brownish yellow color, and is sometimes more than one-third the length of the whole scale; the ventral side is entirely closed, leaving only a narrow transverse slit at the posterior end; the color of the scale is white. Length 6 mm. (.23 inch).

Male.— The male is described by Curtis as being of a bright ochreous color, with the eyes and thoracic band black.

Habitat.— This is a common species on pear and apple in England. Although I do not know of its occurrence in the United States, it will be strange if it is not found here. I am indebted to Mr. Signoret for the specimens from which this description has been prepared.

DIASPIS ROSAE (Sandberg)

THE ROSE SCALE

(Plate V, fig. 1; Plate XVII, fig. 1; Plate XXI, fig. 5)

Aspidiotus rosae Sandberg (1784), Abhand. Priv. Boh., no. 6, p. 317.
Diaspis rosae Signoret, Ann. de la Soc. Ent. de France, 1869, p. 441.

Scale of female.— The scale of the female is circular, snowy white (or, according to Signoret, yellowish white), with the exuviae light yellow, and upon one side; the first skin is naked, the second usually covered with secretion. Diameter 2 to 3 mm. (.08 to .12 inch). (Plate V, fig. 1, natural size; 1*a*, enlarged.)

Female.— The female is elongated, resembling in form a Mytilaspis more than a Diaspis. The head and thorax comprise the larger part of the body. The abdomen is very distinctly segmented, especially upon the sides; each segment presents one or several plates, the two seg-

ments preceding the last a greater number, but usually less than ten. The last segment presents the following characters:

The groups of *spinnerets* are remarkable from the fact that those of each side are often more or less continuous. Signoret states that the anterior group alone is distinct; but in the majority of the specimens which I have studied the lateral groups are more or less distinct. The anterior group consists of about twenty spinnerets; the lateral group are of from twenty-five to thirty-five each. There are three pairs of lobes. The median lobes are large, slightly serrate, approximate at base, and diverging laterally. The second and third lobes of each side are deeply incised; the mesal lobule in each case is the larger.

The *plates* are long, slender, and simple; those nearer the meson are smaller than those farther removed from it; they are situated as follows: one arising from the base of the lateral margin of each of the three lobes of each side; one midway between the meson and the penultimate segment; two to four near the penultimate segment; there are commonly only two in this position, occasionally three, and sometimes four.

The *spines* on the dorsal surface are situated as follows: one very small one on each of the lobes; one on the outer lobule of each of the second and third lobes; one mesad of the fourth plate; and one between the two lateral plates. On the ventral surface there is situated a spine a little mesad of each of the first four dorsal spines.

Scale of male.— The scale of the male resembles that of other species of Diaspis in being long, tricarinated, white, and with the larval skin at one end. Length 1.25 mm. (.05 inch).

Male.— "The male is of a reddish white, with the wings white, the veins of the wings rosy; the venter is a little darker; the style equals the abdomen in length. Antennae and feet yellowish, slightly pubescent." (Signoret.)

Specimens which we bred were bright orange, with the band of the same color, and the eyes black.

Habitat.— This species infests the bark of rosebushes, and is very widely distributed both in Europe and this country. I have collected it in Florida and California, as well as in the Northern States.

From scales collected in Orange County, Florida, the adult males issued in large numbers February 22. At this date some of the females were ovipositing, and many eggs were hatching.

I have also found this species infesting raspberries and blackberries.

Genus **CHIONASPIS** Signoret

This genus includes species of Diaspinae in which the scale of the female is long, sometimes much widened, with the exuviae at one extremity; and the scale of the male long, generally white, more or less carinated (except in *C. ortholobis*), with the sides parallel, and the larval skin at the anterior end. The last segment of the female presents five groups of spinnerets.

This genus resembles Diaspis in the form of the scale of the male and Mytilaspis in the form of the scale of the female; in most species, however, the scale of the female is wider than in Mytilaspis.

CHIONASPIS EUONYMI, new species

(Plate V, fig. 3; Plate XVII, fig. 2)

Scale of female.— The scale of the female is of a dirty blackish brown color, with a gray margin; the first skin is light yellow, the second is

darker, and sometimes is but little lighter than the scale, which is not as delicate in texture as is usual in this genus; the scale is narrow at the anterior end, and begins to widen at about the middle of the second skin and widens rapidly, so that frequently that part posterior to this skin is wider than long. There is a well-developed ventral scale consisting of a single piece, the margin of which, when it is fully formed, completely coincides with that of the dorsal scale, thus inclosing the insect in a complete shell; the two scales are attached by their lateral margins; the posterior margin, however, is free. Length of scale, 1.64 mm. (.06 inch). Width in widest part, 1.23 mm. (.045 inch).

Female.— The body of the female is bright orange-yellow in color; the segments are very well defined; the fifth segment is the broadest; from this segment the insect tapers slowly to the anterior end of the body, and abruptly to the posterior end.

The last segment presents the following characters:

The anterior group of *spinnerets* consists of from four to six; the anterior laterals, five to eight; and the posterior laterals, two to seven, usually four.

The *lobes* are small and finely serrate; the median lobes diverge posteriorly; the second and third lobes of each side are deeply incised, each being divided into two unequal lobules, the larger of which is mesad. Mesad of each of the second and third lobes is a lobe of the unthickened body wall, which bears an elongated pore on its dorsal surface. In many cases the lateral margins of the segment are notched regularly, and each lobe thus formed bears an elongated pore on its dorsal surface.

The *plates* are slender, simple, and tapering; those on the lateral margin of the segment are the largest. There are two plates laterad of each of the first, second, and third lobes, and a pair about midway between the third lobe and the penultimate segment; sometimes in the case of this group of plates and of that laterad of the third lobe there are three of four plates instead of a single pair. The three segments preceding the last bear several (usually five or more) plates on the lateral margins. The penultimate and last segments are connate at the margin of the body.

The *spines* on the ventral surface of the segment are short and inconspicuous; there is one near the mesal member of each of the first, second, third, and fourth groups of plates. The spines on the dorsal surface are quite conspicuous with the exception of the first, which is very slender; it is situated laterad of the base of the first lobe, which it approximates in length; each of the second and third spines is near the base of the incision which divides the corresponding lobes; the fourth spine is mesad of the fourth group of plates.

Scale of male.— The scale of the male is white, tricarinate, with the exuviae light yellow. Length 1.4 mm. (.05 to .06 inch).

Habitat.— On *Euonymus latifolia* at Norfolk, Va. The specimens were received from Mr. Henry P. Worcester, who informs me that this insect has destroyed nearly all of the shrubs of this species in that city. From the account given by Mr. Worcester it appears that only a short time elapses after the plant becomes infested before it is destroyed; but he has not observed this scale insect upon any other plant than euonymus. It was, however, collected in great numbers, by Mr. Howard, upon orange trees in Louisiana, and I have received it from Havana, from which place it may have been imported to this country.

CHIONASPIS FURFURUS (Fitch)

THE SCURFY BARK LOUSE

(Plate VI, fig. 1; Plate XVI, fig. 3; Plate XVII, fig. 3)

"Approaches *Coccus cryptogamus* Dalman." Harris, Insects injurious to vegetation, 1841, p. 203 (Flint ed., p. 254).
Aspidiotus furfurus Fitch, Report N. Y. State Agr. Soc., 1856, p. 352.
Aspidiotus cerasi Fitch, Report N. Y. State Agr. Soc., 1856, p. 368.
Coccus Harrisii Walsh, Practical Entomologist, vol. ii, p. 31, 1866.
Aspidiotus Harrisii Walsh, Report of the Acting State Entomologist of Illinois, p. 53 (1868).
Diaspis Harrisii Walsh, Signoret, Annales de la Société Entomologique de France, 1876, p. 604.

Scale of female.— The scale of the female is flat, irregular in outline, many bending abruptly to the right or left immediately posterior to the second larval skin, others straight; in all the scale suddenly widens near the posterior end of the second larval skin, thus presenting the form characteristic of the genus; length, 2 to 3 mm. (.08 to .12 inch); color grayish white with the first skin light gray and second skin usually brown, sometimes dark gray.

Described from many isolated individuals occurring on smooth bark of a small branch (Fig. 1). On the rough bark of the trunk the scales are much more irregular in form, and are so massed as to appear like a layer of dandruff.

Female.— The body of the female is red, with the last segment light yellow; this segment presents the following characters:

The anterior group of *spinnerets* consists of from eight to thirteen, usually ten; the anterior laterals are from twenty to thirty; and the posterior laterals are from eighteen to thirty-one.

There are three pairs of *lobes*. The median lobes are well developed; the second lobes are smaller, the third are still smaller, being sometimes obsolete; the lobes of the second and third pairs are deeply incised. There are conspicuous elongated pores upon the margin; one laterad of each of the first, second, third, and fourth plates; one cephalad of the incision of the third lobe; and one midway between the third and fourth plates.

The *spines* upon the ventral surface are inconspicuous; the first pair obsolete; the second, third, and fourth pairs at or near the bases of the second, third, and fourth plates. Those upon the dorsal surface are quite long; the first spine of each side is between the bases of the first lobe and the first plate; the second and third spines are upon the lateral lobule of the second and third lobes; and the fourth spine is situated about two-thirds distance from the third to the fourth plates.

Egg.— The eggs are purplish red.

Scale of male.— The scale of the male is very small, being only .75 mm. (.03 inch) in length, narrow, usually straight and tricarinated (Fig. 1*a*); larval skin brownish yellow, remainder of scale snowy white.

Male.— Yellow marked with irregular reddish brown spots; thoracic band reddish brown, sometimes darker than the other markings. Length of body including style, .62 mm. (.02 inch); length of style, .18 mm. (.006 inch). On each side of the anterior part of the thorax there is a black spot which resembles an eye. Other characters represented in figure —.

Habitat.— Harris described it on apple and pear in Massachusetts;

Dr. Fitch found it on pear and chokecherry in New York; Walsh observed it on apple, crab, and the European mountain ash (*Sorbus aucuparia*) in Illinois; and I have found it common in apple and pear in New York, Maryland, and southern California, and upon black cherry in western New York.

Although this insect has been well known for many years, comparatively little has been written respecting it. This is probably due to the fact that there is another species (*Mytilaspis pomorum* Bouché), which, like this, infests the apple, and which is more common and much more destructive. The scurfy bark louse was first described, but not named, by Harris in his *Insects Injurious to Vegetation* (Flint edition, p. 254). In this description both the scale formed by the male and that formed by the female are well characterized; but the insects themselves were not studied by Dr. Harris. The description of the scales is remarkable as containing an explanation of their nature and probable mode of formation as follows: "The minute oval dark-colored scales on one of the ends of these white cases are the skins of the lice while they were in the young or larva state, and the white shells are probably formed in the same way as the down which exudes from the bodies of other bark lice, but which in these assume a regular shape, varying according to the sex and becoming membranous after it is formed." This statement must have been overlooked by Dr. Fitch, who many years afterwards, in his first report as State Entomologist of New York, p. 739 (35), in writing of the oyster-shell bark louse of the apple, states that "these scales are the relics of the bodies of the gravid females, covering and protecting their eggs." And in his second report, p. 489 (257), Dr. Fitch, in describing the pine-leaf scale (*Mytilaspis pinifoliae*) states that the three parts of the scale represent seemingly the head, thorax, and abdomen of the living insect.

Through the kindness of Mr. Lintner and the officers of the New York State Agricultural Society I have had the opportunity of studying the Coccidae in the collection of that society. The specimens were all labeled by Dr. Fitch, and by a very careful study of both the scale and the last segment of the female, of the specimen labeled *Aspidiotus cerasi,* I have been unable to find any character which will separate it from the specimens labeled *Aspidiotus furfurus,* and all of these specimens belong to the same species as the very common pest of the apple and pear, which has been commonly known as *Aspidiotus Harrisii.*

The statement made by Signoret* that this species is the same as that described by Curtis under the name of *Aspidiotus* (*Diaspis*) *ostreaeformis* is evidently a mistake. M. Signoret has kindly sent me specimens of *D. ostreaeformis,* from which I have prepared the description of that species in this report.

CHIONASPIS NYSSAE, new species

THE SOUR-GUM SCALE

(Plate XVII, fig. 4)

Scale of the female.— The scale of the female is snowy white, with the exuviae yellowish. It is flat, quite delicate in texture, and varies greatly in shape; it widens suddenly near the posterior end of the second skin, often becoming as wide as long; some specimens are straight, others are bent to the right or left. Length 1.5 mm. (.05 inch).

*Annales de la Société Entom. de France, 1876, p. 604.

Female.— The last segment of the body presents the following characters:

The anterior group of *spinnerets* consists of six to eight; the anterior laterals of ten to twelve; posterior laterals eight to twelve.

The median *lobes* are large, oblong, joined at the proximal end, and widely separated at their distal extremities; the lateral margins are joined to the body, the mesal margins serrate. The second lobe of each side is incised near its lateral end, the mesal lobule being three times as large as the lateral; third lobe being obsolete.

There are four long simple *plates;* the first and second are laterad of the first and second lobes and are much longer than the lobes; the third plate is midway between the median lobe and the penultimate segment; and the fourth is near the penultimate segment.

The *spines* on the ventral surface are arranged as follows: first pair obsolete; the second, third, and fourth pairs mesad of the bases of the second, third, and fourth plates. The spines upon the dorsal surface are long and conspicuous; there are four pairs, there being a spine mesad of each plate.

Egg.— The eggs are greenish yellow, with purplish markings.

Scale of the male.— The scale of the male is of the form characteristic of the genus, snowy white, with carinae prominent; it is relatively very long, measuring 1.25 mm. (.05 inch).

Male.— The male is greenish yellow, with the thorax and especially the thoracic band darker; eyes purplish.

Habitat.— On the black or sour gum (*Nyssa multiflora*), at Bakersville, N. C. Both male and female occur upon the leaves of the tree.

Described from eight females, thirty scales of the female, four males, and many scales of the male. I am indebted to Dr. R. S. Turner for the specimens.

CHIONASPIS ORTHOLOBIS, new species

(Plate XVI, fig. 6; Plate XIX, fig. 1)

Scale of female.— The scale of the female very closely resembles that of *C. salicis*; it is, however, smaller and narrower. Length, 2 to 2.5 mm. (about .08 inch).

Female.— The body of the female is dark purple; the last segment presents the following characters:

The anterior groups of *spinnerets* consist of from ten to sixteen; the anterior laterals of eighteen to thirty; and the posterior laterals of sixteen to twenty.

The median *lobes* are almost contiguous; their mesal margins are parallel for more than half their length; the distal margin of each is rounded.

Each of the second and third lobes is deeply *incised*; the lateral lobule in each case is very small, often obsolete; the mesal lobule is large and rounded; the distal margins of all the lobes are obscurely crenate.

The *plates* are as follows: one laterad of first lobe; one or two laterad of second lobe; two laterad of third lobe; and two quite large ones quite near the penultimate segment. The penultimate segment usually bears four, and the antepenultimate one.

The *spines* on the dorsal surface are as follows: the first on the base of the lateral part of first lobe; the second and third on the lateral lobule of the second and third lobes, respectively, and the fourth a short distance mesad of the lateral pair of plates. On the ventral surface there are also four on each side; each spine is laterad of the correspond-

ing spine of the dorsal surface, and cephalad of the base of the corresponding plate or group of plates.

Egg.— The eggs are dark purple.

Scale of male.— The scale of the male differs from all other specimens of this genus known to me in not being carinated. It is an elongated oval in outline, being slightly broadest at the middle, and tapering towards both ends almost equally. The larval skin is light yellow; the scale is snowy white.

Described from thirteen males, and many scales of each sex.

Habitat.— On willow, at San Bernardino, Cal. This species infests chiefly the bark of the small whip-like limbs which spring from the trunks of the trees. Many of these sprouts were dead and white with the scales of this species.

The eggs were observed September 12.

CHIONASPIS PINIFOLIAE (Fitch)

THE PINE-LEAF SCALE INSECT

(Plate VI, fig. 2; Plate XVI, fig. 4; Plate XVIII, fig. 1)

Aspidiotus pinifoliae Fitch. Report N. Y. State Agr. Soc., 1855, p. 488.
Mytilaspis pinifoliae Fitch. Le Baron, First Report State Entomologist of Illinois, p. 83.

Scale of female.— The scale of the female is snowy white in color, with the exuviae light yellow; it is usually long and narrow as represented at figure 2*b*; sometimes, however, it is broad, as represented at figure 2*c*. (Scale from leaf of *Pinus pallasiana*.) The shape of the scale apparently depends on that of the leaf to which it is attached. Thus on the broader-leaved pines the broad scales are more common.

Length of scale, about 3 mm. (.1 inch).

Female.— The body of the female is purplish red; the last segment presents the following characters:

The anterior group of *spinnerets* consists of from seven to ten; the anterior laterals of twelve to twenty; and the posterior laterals of fourteen to eighteen.

The median *lobes* are somewhat circular in outline with their distal ends diverging slightly; there is an arched thickening of the body wall connecting the anterior ends of the lobes. The second and third lobes are each deeply incised; the mesal lobule is in each case the larger.

The *plates* are long, simple, tapering to a point, there is one laterad of each of the three lobes of each side, and one midway between the third lobe and the penultimate segment. There are elongated marginal pores in the following situations: One laterad of each of the first and second plates; one at the base of the mesal lobule of the third lobe; two between third and fourth plates; and two between the fourth plate and the penultimate segment.

The *spines* on the ventral surface are so delicate as to be almost invisible; their bases, however, are easily seen; they are situated one mesad of the base of each of the first, second, third, and fourth plates. The spines on the dorsal surface are quite long; the first is near the base of the first lobe, the second between the lobules of the second lobe, the third on lateral lobule of third lobe, and the fourth a short distance mesad of the fourth plate.

Scale of male.— The scale of the male is white and carinated as with other species of this genus. (Plate VI, fig. 2*d*.)

Male.— The male is a uniform orange-red; eyes black.

Habitat.— On various species of pine and spruce throughout the eastern United States from New York to Florida, also pine in California.

CHIONASPIS QUERCUS, new species

(Plate XVIII, fig. 2)

Scale of female.—The scale of the female is long, narrow at the anterior end, much widened posteriorly, and quite convex. The exuviae are brownish yellow; the secretion, of which the remainder of the scale is composed, is white; but all of my specimens appear dark gray, being more or less covered with the hairs of the stem to which the scale was attached and with dust. Length of scale, 2 mm. (.08 inch).

Female.— The last segment of the female presents the following characters:

The anterior group of *spinnerets* consists of about ten; the anterior laterals of seventeen to twenty; and the posterior laterals of ten to eighteen.

This species differs from all Diaspinae known to me in having a single undivided *lobe* on the meson; this lobe is large and rounded distally. The second and third lobes of each side are very small and are laterad of small incisions in the margin of the segment. In each case there is a reniform thickening of the body wall bounding each incision anteriorly. There is also a similar incision with a rudimentary lobe and reniform thickening of the body wall about midway between third lobe and penultimate segment.

The *plates* are inconspicuous and spine-like; there are usually one or two laterad of second ventral spine; two or three between third and fourth lobe and usually five between fourth lobe and penultimate segment. The penultimate and antepenultimate segments bear six each; those on the latter are much expanded at the base.

The *spines* are long and conspicuous; those on the dorsal surface are situated as follows: one on each side at the base of the lateral margin of median lobe, one laterad of each of the second and third lobes, and a fourth one near the center of the anterior group of plates. Those on the ventral surface are as follows: a short one nearly ventrad of the first dorsal spine, a large one laterad of each of the second and third dorsal spines, and a fourth one a little cephalad of the fourth dorsal spine.

Scale of the male.— The scale of the male is snowy white, with the larval skin very light yellow. The texture of the scale is quite loose and the carinae prominent; length 1.25 mm. (.05 inch).

Male.— The adult male is as yet unknown; many pupae were collected August 17, 1880. Specimens of these mounted in balsam are bright yellow in color, with eyes purplish black. Fully grown male larvae in balsam are yellowish brown.

Habitat.— On white oak (*Quercus lobata*) in San Fernando Valley, California. The females occur on the bark of the small limbs; the males upon the leaves.

Described from four scales of the female, four females, hundreds of scales of the male, and many male pupae and larvae.

CHIONASPIS SALICIS (Linn.)

THE WILLOW SCALE

(Plate XVI, fig. 5)

Coccus salicis **Linn.** Syst. Nat., 741, 15.
Chionaspis salicis Signoret. Ann. de la Soc. Ent. de France, 1869, p. 447.
Chionaspis fraxini. Signoret, l. c., p. 445.
Aspidiotus salicis-nigrae Walsh. Report Acting State Entomologist, Illinois (1868), p. 40.
Mytilaspis salicis **Le Baron.** Second Annual Report State Entomologist, Illinois (1872), p. 140.

Scale of female.— The scale of the female is of the form characteristic of the genus, being long, narrow at the anterior end, and broadly widened posteriorly. Exuviae dark yellow, normally covered by a thin layer of white excretion; this, however, is easily removed. Scale snowy white. Length 3.4 mm. (.13 inch); width near posterior end, 1.6 mm. (.06 inch).

Female.— The body of the female is reddish. The last segment (Plate XVI, fig. 5) differs from that of *C. ortholobis* as follows: the median lobes are joined at the base, and are widely separated at their distal extremities; between the first plate and the second lobe and mesad of the third lobe are prolongations of the body wall, which extend caudad as far as the lobes, and bear elongated pores. Immediately laterad of the third group of plates is a prominent prolongation of the body bearing an elongated pore, while in the case of *C. ortholobis* this is situated at one-third the distance from the third to the fourth group of plates. In *C. salicis* the two lateral groups of plates often consist of three instead of two, and the penultimate segment bears at least six plates, the antepenultimate three or four, and the one anterior to this, one or two.

Scale of male.— The scale of the male is long, narrow, with the sides nearly parallel. It is tricarinated and snowy white, with the exuviae yellowish.

Habitat.— Infesting willow and ash in Europe and in the United States.

Specimens of "*Chionaspis fraxini*" received from England are identical with *Chionaspis salicis* received from M. Signoret. I have also received this species from Ithaca, N. Y., and from Saint Louis, Mo., in each case upon willow.

Genus **MYTILASPIS** (Targ.-Tozz.)

This genus includes the species of Diaspinae in which the scale is long, narrow, more or less curved, and with the exuviae at the anterior extremity. The scale of the male resembles that of the female in form; but it can be readily distinguished by its small size, and by bearing only one larval skin.

In all the species of Mytilaspis which I have studied the posterior part (about one-fourth) of the scale of the male is joined to the remainder by a thin portion which serves as a hinge, allowing the posterior part to be lifted when the male emerges.

MYTILASPIS CITRICOLA (Packard)

(Plate VII, fig. 1; Plate XX, fig. 3; Plate XVIII, fig. 3)

Aspidiotus citricola Packard. Guide to the study of insects, second edition (1870), p. 527.*

Scale of female.— The scale of the female is long, more or less curved, and widened posteriorly. It is brown with the exuviae of the same color and with a delicate margin (Fig. 1*a*). The ventral scale is well developed; it is white, and consists of a single piece which is slightly attached at its sides to the lower edge of the scale, and is more or less incomplete posteriorly (Fig. 1*b*). Length of scale, 3 mm. (.12 inch).

Female.— The female is yellowish white. The characters of the last segment are as follows:

The anterior group of *spinnerets* consists of about six; the anterior laterals of about eighteen, and the posterior laterals of about nine.

The median *lobes* are well developed with the margins crenate; the second lobe deeply incised, with the margins of the lobules either entire or crenate; the third lobe is quite inconspicuous, projecting but little beyond the body wall, the margin crenate and one large notch in the center of the lobe.

The *plates* are long, simple, and tapering. There are two of them in each of the following places: between median lobes; between first and second lobes; between second and third lobes; laterad of third lobe; and about midway between this lobe and the penultimate segment. There is an elongated pore between first and second lobes; two laterad of each of the third and fourth pairs of plates; and one laterad of the fifth pair of plates. The penultimate segment bears at least four plates upon each lateral margin.

The *spines* upon the dorsal surface are long, and are situated as follows: one at the base of each margin of the first lobe; one dorsad of incision of second lobe; one dorsad of the notch of third lobe; and one about midway between the fourth and fifth pairs of plates. Those of the ventral surface are as follows: cephalad of the bases of the first pair of plates are two small spots which resemble the bases of spines, and are doubtless the homologues of the first pair; the second spine of each side is near the base of the lateral half of the first lobe; third spine laterad of lateral lobule of second lobe and fourth and fifth spines between the members of the fourth and fifth pairs of plates respectively.

Egg.— The eggs are white and are arranged irregularly under the scale.

Scale of male.— The scale of the male is usually straight, or nearly so; the same color as that of the female, or in some specimens varying to a very dark brown, almost black, the larval skin light yellow. At about one-quarter of the length of the scale from the posterior extremity, the scale is thin, forming a hinge which allows the posterior part of it to be lifted by the male as he emerges. Length 1.5 mm. (.06 inch).

* The descriptions of *Aspidiotus Gloverii* and of *Aspidiotus citricola* given by Packard in his *Guide to the Study of Insects*, p. 527, are not only unrecognizable *per se*, but are merely descriptions of unpublished figures, and consequently have no claim to recognition. But a desire to prevent confusion has led me to adopt these specific names. I have had no hesitation in doing this, because a very careful search which I have made of many orange groves in Florida has revealed the fact that there are only two species of Mytilaspis common on citrus trees in that State, and consequently there can be but little doubt that they are the species which Professor Glover figured. To the form with the narrower scale I apply the name *Gloverii*, to the other that of *citricola*.

Development of the insect and formation of the scale.— Upon March 15, 1880, observations were commenced upon a brood of young lice just hatching. Their color was white, yellowish at both ends, and with red eyes; antennae 6-jointed; margin of the head as far as the eyes tubercled, and each segment of the abdomen with a lateral piliferous tubercle. When placed upon a young orange tree, all settled in from fifteen to twenty minutes. Twenty-four hours later no change had taken place except that the cottony excretion referred to in the general remarks was already observable at the posterior end of the body. Forty-eight hours from the time of hatching the cottony mass had increased to such an extent that only the anterior fourth of the larva could be seen. The secretion was dense and compact, and a few long, very fine, rather curly threads of a yellowish color protruded from it. Each side of the head a fine curl of the cottony substance extended forward and, from the frontal border of the head, filaments of the same extended at equal distances. At seventy-two hours the dense excretion had covered the eyes. Behind the head in most specimens there was a marked constriction in the covering, which in some, however, was but slightly indicated.

From this period up to the age of ten days the alteration was but slight. The covering had increased so as to extend beyond the head of the insect. Removing the covering, it was noticed that nearly all trace of the segmentation of the abdomen was gone, and that it was oval in form. Upon abdominal joints 1, 2, 3, and 4, four rows (two dorsal and two lateral) of pale transparent spots were noticed. From this time (March 25) on until April 6, the changes in the body of the insect were very slight. The skin was gradually separating from the body within, and toward the latter part of this period the abdominal outline of the latter with its notches could be plainly seen through the first larval skin. April 6, or twenty-two days from hatching, the larvae molted their first skin. In preparation for this act they worked their way partly out of their excreted cases, sometimes destroying the anterior end in the effort. In the act of molting the skin splits ventro-transversely between the thorax and the abdomen, and the abdomen is first drawn forward and thrust through the aperture. How the remainder of the body is disengaged is not precisely known — whether it is drawn down through the same split, or whether the anterior part of the old skin has a longitudinal ventral split — but the latter is probably the case. The color of the insect after this first molt is white with pale orange eyes and a tinge of yellow to the proboscis, to the alimentary canal, and to the end of the body. Great irregularity was noticed in the time of shedding of the skin, some finishing two weeks before others, and after the molt was completed some were covered entirely and hidden from view by the cast-off skin and waxy secretion; while others were partly exposed. The old covering began to melt gradually and the new scale began to form at the posterior end of the body, at first resembling compact scum or froth, and six days after the molt it was already from three to four times the size of the shed skin which adheres to the outside of the forming scale, covered as to its anterior half by the remains of the woolly secretion of first stage.

From this time on till forty days from the time of hatching the scale grew gradually as also the inclosed insect, the former at this time changing from white to yellowish brown, having precisely the appearance of the full-grown scale except as to size. At forty-four days after hatching, the scales were about one-fourth the size of the full-grown. At forty-six days it was observed that the male larvae were rapidly maturing and that already traces of antennae and legs were to be seen. At fifty-four

days the more advanced individuals shed the second skin and appeared as pupae. About the same time the females also cast their second skin. Our notes do not show the exact length of time which the males remained in the pupa state, but that it is very short is shown by the fact that on May 18 pupae from eggs hatched March 30 were observed to transform to adults, the old pupa skin being pushed backward out of the scale. The description of the adults of both sexes has already been given.

At eighty days the females were observed to have deposited eggs and already the young had begun to hatch. Later in the season the development is more rapid than that just detailed. From eggs which hatched May 22, males were reared June 25, a space of thirty-four days, while the females of the same generation had begun to oviposit July 12, or fifty-one days from hatching.

Habitat.— This is one of the two most common species of scale insects found on citrus trees in Florida. It is probably an European species, as I have frequently found it on imported oranges in our market. It also occurs in Louisiana. Mr. Glover states (Report Department of Agriculture, 1855, p. 119) that this species was imported into Jacksonville, Fla., in 1855, on some lemons sent from Bermuda.

MYTILASPIS GLOVERII (Packard)

GLOVER'S SCALE

(Plate VII, fig. 2; Plate XVIII, fig. 4; Plate XXI, fig. 1)

Coccus Gloverii (Packard). Guide to the study of insects (1869), p. 527.
Aspidiotus Gloverii (Packard). Ibid., second edition (1870), p. 527.
Mytilaspis Gloverii (Packard). Ashmead, Orange insects (1880), p. 1.

Scale of female.— The scale of the female in this species differs from that of *M. citricola*, with which it is often associated, in being much narrower (Plate VII, fig. 2, natural size; 2*a*, enlarged). Color light yellow, varying to dark brown; the ventral scale is white and consists of two long narrow parallel plates between which is an open space (Plate VII, fig. 2*c*.)

Female.— The body of the female is light purple in color, with the last segment yellowish; this segment presents the following characters:

The anterior group of *spinnerets* consists of five; the anterior laterals about eleven, and the posterior laterals of five.

The *margin of the segment* is the same as in *M. citricola* with the following exceptions: the first lobe on each side is abruptly narrow, then prolonged more or less into a point, with the margins scarcely serrate; lobules of second lobe longer and narrower.

The *spines* are very small; the ventral one on the median lobe invisible. There are only two plates on the penultimate segment.

Egg.— The eggs are white when first laid, but become tinged with purple before hatching. They are arranged in two rows in a very regular manner. (Plate VII, fig. 2*c*.)

Scale of male.— The scale of the male is similar in form to that of the female, except that there is but a single molted skin, and the scale is furnished with a hinge like that described under head of *M. citricola*.

Male.— For figure of male see Plate XXI, figure 1.

Development of the insect and formation of the scale.—Our observations show that the development of Glover's scale is up to a certain point almost parallel with that of *M. citricola*, and that its failure at that point may be abnormal will be seen from what follows. March 27, eggs under

observation began to hatch. The young larvae are purplish, with the front of the head and the margin of the body yellowish. Most of them settled almost immediately, and at two days the cottony excretion had covered one-half the insect. At four days it reached beyond the eyes, and the larva itself seemed to be more elongated, with the joints more distinct. At six days most of them were entirely covered, with the excretion extending like two horns at each side of the head. With some there were only two or three transverse constrictions of the covering, giving them a very peculiar appearance. At seven days the future dentate appearance of the abdomen could already be detected through the skin, and at eleven several presented every appearance of a speedy molt, having pushed themselves forward from the covering. They remained in this state, however, without marked change, except that some secreted a tuft of the waxy threads, which rose erect for two or three times the length of the scale, for twelve days more before shedding their first skin, which was done at the age of twenty-three days. The molt was performed in precisely the same manner as with *M. citricola.* Immediately after the molt the whitish permanent scale began to form. At thirty-two days one could begin to distinguish the legs and antennae of the future pupae in the males. At forty-four days the first female was observed to have cast its second skin; the color after the molt is white, with the anal segment and middle of the body yellowish. About the same time the males became pupae, and at forty-five days the first adult male was found. From this time up to the age of one hundred and two days the female scales were watched daily, but no eggs were observed. At this age all either died or were mounted, so the age at which the eggs are deposited has not been determined. It may be that the non-development in this case was due to the fact that the females had not been fertilized.

Habitat.— This is a very common species on citrus trees in Florida and Louisiana. It infests the fruit, leaves, and bark of the trees, and is usually associated with *M. citricola.* It is supposed that it was introduced into Florida about forty years ago by Mr. H. B. Robinson, who owned a grove at Mandarin. Mr. Robinson is said to have purchased two trees in New York from a ship from China. From these trees the insect is said to have spread.*

Trees which this department received from Europe were badly infested by this scale insect. This, however, does not prove the European origin of the pest, as it may have been carried there from China.

MYTILASPIS? PANDANNI, new species

(Plate XX, figs. 1 and 2)

Scale of female.— The scale of the female is light brown in color, with the posterior end paler and sometimes white; the first larval skin is naked; the second, which is large, is covered with excretion. The shape varies greatly. Some specimens broaden gradually from the first larval skin to near the posterior end; in some the lateral margins are more or less curved, so that the scale is broadest at or near the middle; others are suddenly widened near the middle of the second larval skin.

Females.— The body of the female is yellowish; the last segment presents the following characters:

The anterior group of *spinnerets* consists of four; the anterior laterals of nine or ten; the posterior laterals of ten to twelve.

*See Glover, Report Department of Agriculture, 1855, p. 117.

There are two pairs of *lobes*; each lobe is small; the mesal margins of the median lobes are parallel; between these lobes is an incision extending cephalad of base of lobes for a distance equal to one-half of length of lobes. The second lobe of each side is deeply incised; the mesal lobule is the largest and longest.

The *plates* are simple, tapering, and longer than the lobes. There is one laterad of each of the lobes; one a little less than half the distance from the first lobe to penultimate segment; and one near the latter. The penultimate segment usually bears two and the antepenultimate one.

The *spines* on the dorsal surface are quite long, and are situated as follows: first, laterad of first lobe; second, upon the lateral lobule of second lobe; third, at about two-thirds the distance from second to third plates; and fourth, at two-thirds the distance from third plate to fourth plate.

Between the first plate and mesal lobule of second lobe is a *projection* of the body as long as the latter, which bears an elongated pore.

Described from fourteen females and many scales.

Habitat.— This species was collected by Mr. Trelease, upon Pandannis, in the Harvard Botanic Garden, at Cambridge, Mass.

The scale of this insect varies greatly from the typical form of Mytilaspis. The species is evidently closely allied to the *M.*(?) *buxi* (Bouché) as described by Signoret.

MYTILASPIS POMORUM (Bouché)

THE OYSTER-SHELL BARK LOUSE OF THE APPLE

(Plate XIX, fig. 2)

Aspidiotus pomorum Bouché. Ent. Zeitung Stett. (1851), XII, no. 1.
Aspidiotus conchiformis of authors: but not *A. conchiformis* Gmélin, Syst. Nat., 2221, 37 (1788), which species infests elm.
Aspidiotus pyrus-malus Rob. Kennicot (1854), Acad. Science of Cleveland.
Mytilaspis pomicorticis Riley. Fifth Report State Entomologist, Missouri, p. 95.
Mytilaspis pomorum (Bouché). Signoret, Ann. de la Soc. Ent. de France, 1870, p. 98.

Scale of female.— The scale of the female is long, narrow, widened posteriorly, more or less curved, of an ash gray color with the exuviae yellowish. Length, 2 mm. (.08 inch).

Female.— The body of the female is yellowish white. The last segment presents the following characters:

The anterior group of *spinnerets* consists of from eleven to seventeen; the anterior laterals and posterior laterals each of sixteen to twenty-one.

The median *lobes* are large and wide, with the sides parallel; they are only about three-fourths as long as broad; each lobe is narrowed on each side near the distal extremity by one or two notches and then rounded. The second lobe of each side is about as wide as the first, and is deeply incised; mesal lobule with mesal margin as long as lateral margin of the first lobe, and rounded posteriorly; lateral lobule about half the length and width of mesal lobule and similar in shape. Third lobe obsolete.

The *plates* are arranged as in *M. citricola*; the lateral members of the second and third pairs are shorter and smaller than the mesal. The penultimate segment bears two pairs on each side.

The *spines* are as in *M. citricola* except that the first dorsal pair are not so conspicuous.

Scale of male.— The scale of the male of this species closely resembles those of *M. Gloverii* and *M. citricola*, being much smaller than that of

the female, straight or nearly so, with a single molted skin, and with the posterior part joined to the remainder of the scale by a thin portion which serves as a hinge.

Male.— I have not bred the male from apple. Its color is described by Riley* as being translucent corneous gray with a dorsal transverse band on each joint, and the portions of the mesothorax and metathorax darker or purple gray, and with the members somewhat lighter.

Habitat.— This is an imported European species, which is common throughout the greater part of those sections of the United States where apples are grown to any great extent. It is, however, much more common in the cooler parts of the country, being replaced to a certain extent by *Chionaspis furfurus* in the warmer sections.

There is but a single generation of this insect each year in the North, where the eggs hatch in the latter part of May, or early in June, and two generations in the South.

This species is said to infest many different plants; but in nearly if not every case the opinion respecting the specific identity of the forms occurring on other plants with that upon apple has been based upon the characters presented by the scale. These characters being insufficient to distinguish this species from closely allied forms, it is very desirable to confirm these observations. I have, however, found about twenty different species of plants infested by one or more species of Mytilaspis, which, after the most careful study of structural characters, I am unable to distinguish from *M. pomorum.* The greater part of these plants are trees growing in the parks and along the streets of Washington; and if the scale with which they are infested is *M. pomorum,* it is a very remarkable fact that, notwithstanding the abundance of it on these trees, apple trees growing in the immediate vicinity are not infested, and, too, although the male of *M. pomorum* is rare on apple, it is not at all so on the other plants. The following is a list of the plants upon which I have found this form of Mytilaspis: linden, hop tree, bladder nut, horse-chestnut, maple, an exotic amorpha, water locust, raspberry, hawthorn, currant, *Ribes alpinum, Lonicera pulverulenta,* ash, elm, hackberry, *Planera kakii,* willow, poplar, and yucca.

Genus **PARLATORIA** Targioni-Tozzetti

The following are the characters of this genus as given by Signoret: "Species of which the scale of the female is long, narrow at the base, then enlarging suddenly; the exuviae of a rounded oval form." "Four groups of pores only."

"The margin of the anal segment is indented and presents in each notch some plate-like scales." "On the upper side near the margin two rows of isolated pores." "The scale of the male of the same color as that of the female and much smaller."

Only two species of this genus have been described: *P. proteus* Curtis and *P. zizyphi* Lucas; I add a description of a third. A comparative study of *P. zizyphi, P. pergandii,* and two undescribed species in the collection of the department shows that there is very little variation in the *number* of the appendages of the last segment of the female; specific characters are to be found in the *shape* of these organs, and the *position* of the spines. I have not seen *P. proteus.*

* Fifth Missouri Report, p. 95.

PARLATORIA PERGANDII, new species

PERGANDE'S SCALE

(Plate XI, fig. 4; Plate XX, fig. 5; Plate XXI, fig. 8)

Scale of female.— The scale of the female varies in form; sometimes it is nearly circular in outline, with the exuviae upon one side; usually, however, it is somewhat elongated, with the exuviae at one end; color of scale, dirty gray; the first skin is naked; the second is covered with a very thin film of secretion, and occupies about one-third of the length of the scale; length of scale, 1.6 mm. (.06 inch).

Female.— The female is nearly as broad as long, and varies greatly in color; some specimens are almost entirely white, with only the end of the body slightly yellow; others are entirely yellow, and some are purplish, with the posterior end of the body yellow; eyes black. The last segment presents the following characters:

There are only four groups of *spinnerets,* each usually consisting of eight or nine; but the number in each group varies from four to ten.

There are three pairs of well-developed *lobes;* each lobe is widest near the middle, tapering anteriorly, and suddenly narrowed posteriorly. There is a fourth rudimentary lobe upon each side about midway between the third lobe and the penultimate segment; this lobe is irregularly rounded and produced into a papilla at its distal extremity; there is a similar lobe on the penultimate segment, cephalad of the posterior plate of that segment. Connecting the bases of the lobes are crescent-shaped thickenings of the body wall, which are in reality the thickened margins of elongated pores placed at right angles to the median line of the body. There is one of these pores in each of the following places: between median lobes; between median and second lobes; between second and third lobes; and there are two between third and fourth lobes; also two between fourth lobes and the penultimate segment.

There are two *plates* between the median lobes; two between first and second lobes; and three between second and third lobes. These are similar in shape, and in each case extend caudad as far as the tips of the lobes. Each plate is oblong, with the sides parallel and with the distal extremity fringed. Between the third and fourth lobes are three plates varying in shape from the form just described to palmate; the middle member of this group is usually as large as the other two combined. The three plates cephalad of the fourth lobe are usually palmate.* The three segments preceding the last usually have five or six plates each, on each lateral margin; these plates are rounded and produced into a single papilla at the distal extremity. The fourth segment preceding the last often bears one or two plates also.

Each lobe bears a *spine* on its dorsal surface; that of the fourth lobe is situated near the center of the lobe; each of the others is near the lateral margin of the base of its lobe. The spines on the ventral surface (except the first, which is obsolete) are longer and more conspicuous; the second, third, and fourth are each situated dorsad of the lateral margin of the first plate, laterad of the second, third, and fourth lobes, respectively. Each of the three segments preceding the last bears a conspicuous spine near the middle of each lateral margin.

* In the most closely allied of the described species—*Parlatoria proteus* Curtis—the plates of the last segment according to the figures and description of Signoret have a different form, being smooth on the mesal margin and serrate on the lateral.

Egg.— The eggs and young larvae are purplish. Twenty-seven eggs were observed under one scale; but in another instance the abdomen of a female was more than half filled by five eggs.

Scale of male.— The scale of the male is long and narrow; the larval skin is at the anterior end, and occupies a little more than one-third of the length of the scale; the lateral margins of the scale are prominent; the central part is not carinated and is very seldom higher than the sides; usually, and especially with old scales, after the adult has emerged the central part is depressed, giving that part of the scale posterior to the larval skin the form of a gutter.

The larval skin is grayish yellow, with the central part a very dark green; the excretion is light gray; length of scale, 1 mm. (.04 inch).

Male.— The male is purplish in color, with the disk of the thorax nearly colorless, with the exception of some irregular purplish spots, and the sutures, which are brownish; the eyes are large and very dark. (Plate XXI, fig. 8.)

Habitat.— This species infests the trunk, leaves, and fruit of the citrus trees in Florida. It occurs more abundantly on the bark of the small limbs than on any other part of the tree; occasionally, however, it very thickly infests the fruit. Frequently it may be found on Florida oranges in the northern markets, but I have never observed it on imported fruit. And as I have not yet found it infesting native plants I can offer no suggestions as to whence it came. The scales so closely resemble the bark in color that a tree may become very badly infested before attracting attention.

Number of generations per year.— The length of time occupied by a generation of this species varies greatly, according to the season of the year. Thus we observed that in a brood which hatched March 31 the larvae began to molt on the twenty-second day; the first male pupa was observed on the forty-second day; the second molt of the females began on the forty-fifth day; the first adult males were observed on the forty-ninth day; and the females did not begin to oviposit until they were more than two months old. In another brood which hatched April 26 there were developed females which began to oviposit on the forty-fifth day. And the females of still another brood which hatched June 23 began to oviposit when only forty-one days old. These observations were made in the breeding-room of this department in Washington. In the open air in Florida the periods are probably even shorter.

It gives me great pleasure to dedicate this important species to Mr. Th. Pergande, whose patient labors, although but little known to the public, have done much to advance economic entomology.

Genus **FIORINIA** Targioni-Tozzetti

This genus includes species of Diaspinae in which upon the scale of the female only one larval skin is visible at the anterior extremity; the second skin is present, but it is entirely covered by secretion. This skin is large, covering the insect entirely. The scale is narrow at its anterior end; it soon widens, and the sides are parallel throughout the greater part of its length. The three anterior groups of spinnerets are united, forming a continuous line.

The scale of the male is similar to that of the female, but smaller.

Only one species of this genus has been described heretofore — the *Fiorinia pellucida* of Targioni-Tozzetti — which is said to be common on many plants in hothouses, and especially upon *Areca aurea* and *Phytelephas macrocarpa*. As yet this species has not been reported from

this country. We have, however, a very pernicious pest which belongs to this genus, and of which I offer the following description:

FIORINIA CAMELLIAE, new species

(Plate XI, fig. 7; Plate XIX, fig. 4; Plate XX, fig. 4)

Scale of the female.— The scale of the female is yellowish brown, with the larval skin yellow, and a thin margin to the remainder of the scale white. That part of the scale which covers the second skin has a prominent, longitudinal, central ridge, which is dark brown; the sides of the scale sloping from this ridge are more or less wrinkled.

Female.— The fully grown female is of a pale yellowish brown color, with large irregular lemon-yellow spots. The last segment presents the following characters (Plate XIX, fig. 4, and Plate XX, fig. 4):

The anterior group of *spinnerets* consists of about nine, arranged in a single row; the anterior laterials of about nine each, usually in a double row, and continuous with the anterior group; and the posterior laterals of about sixteen, arranged more or less regularly in a double row.

There are only two pairs of *lobes* present, and their margins are conspicuously serrate. The caudal extremity of the segment is deeply notched, and the first pair of lobes is borne by the margins of this notch. The second lobe of each side is deeply incised; the median lobule is the larger.

The *plates* are simple, slender, tapering, and extend caudad of the lobes; there is one laterad of each lobe, and sometimes one on the lateral margin of the segment.

There is an elongated *pore* laterad of each of the first and second plates; one nearly midway from the end of the body to the penultimate segment, and one near that segment.

There is a pair of *spines* between the median lobes, which appear to be neither ventral nor dorsal. The spines on the dorsal surface are as follows*: one delicate one laterad of anterior portion of first lobe; a larger one posterior to it at the base of the first plate; a large one on the lateral lobule of second lobe; a similar one about midway between the second and third pores, and also one between the third and fourth pores. On the ventral surface there are only three spines on each side; one at the base of the second plate, and one laterad of each of the two lateral spines of the dorsal surface.

Egg.— The eggs and young larvae are lemon-yellow.

Habitat.— This is a very troublesome pest of the camellia in the conservatories of this department. It also infests a palm (*Kentia balmoriana*) and *Cycas revoluta.*

Genus **ASTERODIASPIS** Signoret

The females of this genus resemble those of Asterolecanium Targ.-Tozz. Around the lateral edge and upon the dorsum are spinnerets, which secrete a fringe which persists upon the sides but which upon the back melts down and forms a continuous whole, which constitutes in the old individuals a hard and consistent shield, slightly iridescent, which covers the whole insect. When the females have deposited their eggs, the body shrinks up into the cephalic end of the covering so that

* Note that the figure of the margin of this segment (Plate XIX, fig. 4) represents the *dorsal* surface. In all other cases in this report the figures of the last segment represent the *ventral* surface.

there appears to be only a sac inclosing the eggs, which one would naturally take to be the body of the female. The male scale is of a long oval, with a weak median carina, and showing under the microscope an elegant fringe around the edge similar to that of the female scale.

ASTERODIASPIS QUERCICOLA (Bouché)

(Plate XI, fig. 9)

Adult female.— Of a dark brown or a clear yellow color, nearly round in outline, furnished at the anal extremity with a rounded lobule and above with transverse striae, which represent the abdominal segmentation. Diameter from 1 to 2 mm.

The skin is covered with quite a large number of tubular *spinnerets.* The circumference of the body is ciliated with a fine radiating fringe secreted by openings upon the edge of the body. This fringe is double, formed of a row of large tubes joined together two by two, secreted by double openings, and another row, smaller, secreted by smaller openings placed below the others.

These insects are very closely applied to the bark, forming for themselves, in fact, slight depressions, so that it is very difficult to lift them. Occasionally, however, one of the yellow scales (in which the body of the insect has shrunken up to the end) is slightly elevated at one side, perhaps to allow for the exit of the young. On lifting one of the scales there remain upon the bark floury marks corresponding to the stigmata.

Male.— The male scale is of a long oval, 1 mm. in length by 0.6 mm. in width; of a clear brilliant yellow with a weak median carina, and with a fringe similar to that of the female.

The male is brownish yellow upon the head and thorax, and of a clearer yellow upon the abdomen, the base of which is a little darker; the antennae and legs almost black, the prothorax and mesothorax darker than the rest, the transverse band of the metathorax perfectly black as well as the eyes. The wings are large and of a transparent whitish gray. The abdomen is large and rounded; the stylet is dark yellow and .35 mm. long.

Habitat.— Upon the imported oaks on the Department of Agriculture grounds at Washington. Only the females were found and the male description is taken from Signoret. The species is not a common one in Europe, but is occasionally quite destructive to an individual tree.

Subfamily LECANINAE

Genus CEROPLASTES

The species belonging to this genus are furnished with a thick covering of waxy material, which does not, however, adhere closely to the insect. This covering is formed of layers secreted by the spinnerets. Some of the species have tuberosities upon the back which are larger or smaller according to the age of the insect, and which entirely disappear at full growth, when, from being more or less flat with tuberosities or nuclei with concentric lines, they become smooth and globular. The antennae are 6-jointed, the third being the longest. (In the larva state the fourth and fifth appear as one.) The legs are long. The claw is furnished with four digitules, of which the two shortest are very large and horn-shaped.

The male of this genus is not known.

CEROPLASTES FLORIDENSIS, new species

THE FLORIDA CEROPLASTES

(Plate IV, fig. 2)

Adult female.— Subglobular in form, the point of attachment to the twig or leaf being concave. Length from 2.5 to 3 mm. Color, when naked, reddish brown; covered with an apparently homogeneous layer of waxy excretion, which is usually brownish on the dorsum and dirty white towards the edges; some specimens are irregularly mottled brownish and yellow-white. Antennae 6-jointed, joint 3 nearly as long as all the others together. Legs normal in all respects. The margin of the body in the region of the stigmata is furnished with groups of minute arrow-shaped tubercles, constricted at the base, and between these groups bristle-shaped spinnerets. (We doubt whether these arrow-shaped tubercles will prove of specific value, but they are only mentioned by Signoret in two species, *C. Vinsonii* and *C. Fairmairii*, in the former case accompanied by the bristles, in the latter without them.)

Egg.— Ellipsoidal in form; 0.25 mm. long and about half as wide. Color, light reddish brown.

Newly hatched larva.— Moderately slender; antennae 6-jointed, joint 6 furnished with a number of very long hairs. Tarsi as long as tibiae; the two digitules of the claw are slender and but slightly expanded at the tip; of the other two tarsal digitules, the distal one is very short and slender and with but a very slight expansion, while the proximal is long and stout and has the normal appearance. The two bristles of the pre-caudal lobes are very long, while those of the caudal lobes are very short. The color is light reddish brown, with slightly paler legs and antennae.

Growth of insect.— The young lice are very active, and upon hatching spread at once in all directions, settling usually in from one-half to three-quarters of an hour, and usually upon the upper surface of the leaf near the midrib. While engaged in inserting the proboscis into the leaf the legs and antennae are all in motion, but once fixed they are all drawn under the body, and the insect appears motionless and memberless. At two days after hatching, two parallel dorsal ridges of white secretion, meeting in front and behind and dentate along the inner edges, made their appearance.* At three days these ridges were plainer, divided transversely at the middle, and some of the inner dentations had grown so as to touch those of the opposite side. Around the subdorsal portion were bits of white secretion, apparently eight on each side, one behind each eye, and a larger one between the eyes. At five days the subdorsal spots had increased in size, especially the one between the eyes, and the first, second, and fourth thoracic pairs and the seventh and eighth abdominal pairs. (There are now seen to be four thoracic and eight abdominal pairs of these spots in addition to the large one between the eyes.) The dorsal secretion at this time forms almost two compact masses, leaving only a very narrow line through which the body is still to be seen. At six days the dorsal secretion had become entirely united, and the tufts, as we may now call them, increased in length, the first abdominal pair being shortest and the others towards

* The periods given here are as noticed in a cool breeding-room at Washington; in Florida they are probably shorter.

the anal end gradually increasing in size. At nineteen days the dorsal secretion had formed a compact oval mass, and there were fifteen distinct lateral tufts to be seen, seven on each side and one at the point. At this stage all the specimens which we have attempted to rear have died. Many lived for months without perceptible change, and the conditions are probably not favorable for the production of further secretion or for the change of the white tufts into the waxy plates which are seen in the next stage of growth.

When the insect has attained a length of from 1.5 to 2 mm., it is found to be covered with nine irregular waxy plates, the central one very small and the six lateral ones larger, of an irregular oval in shape, while the cephalic and caudal ones are triangular, the apex of the triangle towards the central plate. Near the center of each of these plates is usually a small bit of the white secretion (usually larger with the central plate than any other). The plates are even at this time not well differentiated, and, with the increase of the insect in size, the dividing lines become lost, the lateral plates extend over the central, until at full growth the wax presents the appearance of a continuous, even covering. At any time previous to full growth, after the plates have been formed, if the waxy shield be removed, six very large prominences will be observed, three on each side of the insect, corresponding to the six original lateral plates. As the body fills with eggs and expands, these tuberosities grow less perceptible, until in the old female they are not to be seen at all.

The half-grown specimens are usually dirty yellowish white in color, often tinted with pinkish or reddish brown.

Food plants.— While the principal economic importance of this species is derived from the fact that it is to be found upon all the different citrus plants in different parts of Florida, yet it is also found upon fig, pomegranate, guava, tea (?), quince, and Japan plum (*Biotrites Japonica*). I have also found it upon red bay, oleander, sweet bay, very abundantly upon the gall berry (*Ilex glabra*), upon the common myrtle, and upon an ericaceous plant belonging to the genus Andromeda.

Synonymical.— This species is treated under the name of *Ceroplastes rusci* Linn. by Mr. Ashmead in his *Orange Insects*, and what is probably the same insect was similarly identified by Professor Riley in the Department of Agriculture report for 1878, p. 208. Compared with *C. rusci*, however, *C. Floridensis* presents several marked differences, the most easily noticeable being the small size of the central plate and its entire disappearance so early in the life of the insect. With *C. rusci*, according to the figures of Targioni and Signoret, the central plate is much larger than any of the others, and continues so as long as any dividing lines can be observed.

From the specific name which I have given this insect it will be seen that I consider it indigenous. I found it common in all parts of Florida which I visited, even upon the pine barrens, many miles from any orange grove. Moreover, I have always found it more abundant upon the gall berry than upon the orange or any cultivated plant. Mr. Ashmead considers it as imported, but his specific identification has undoubtedly misled him.

The orange growers cannot expect to free their groves from this insect so long as the gall berry grows about them as abundantly as it does in some places. I have always found those bushes growing in wet places more extensively infested than others.

CEROPLASTES CIRRIPEDIFORMIS, new species

THE BARNACLE SCALE

(Plate IV, fig. 3)

Adult female.—Average length 5 mm., width 4 mm., height 4 mm. When naked the color is dark reddish brown; the shape sub-globular, with a strong spine-like projection at the anal end of the body. The waxy covering is dirty white, mottled with several shades of grayish or light brown, and even in the oldest specimens retains the division into plates, although the form is more rounded and the dividing lines by no means as distinct as at an earlier age. There are visible a large convex dorsal plate, and apparently six lateral, each with a central nucleus; the anal plate, however, is larger, and shows two nuclei, and is evidently two plates joined together. Antennae 6-jointed, and proportioned as with *C. Floridensis.* Legs long; tibiae nearly twice as long as tarsi; digitules of the claw very large. The other tarsal pair very long and slender, but with a very large button. The skin is seen in places to be furnished with many minute, round, transparent cellules, probably *spinnerets* (indicated and so called by Signoret in his description of *C. Vinsonii*), and along the border are small groups of the constricted arrow-shaped tubercles mentioned in the last species; but the bristle-shaped *spinnerets* seem to be wanting, as in *C. Fairmairii* Targ.

Egg.— Length 0.35 mm., rather slender, little more than a third as thick as long. Color light reddish brown, rather darker than the egg of *C. Floridensis.*

Young larva.— Very slender; dark brown in color; legs and antennae as with *C. Floridensis.*

Growth of insect.— The growth of the insect and the formation of the waxy covering seems to be very similar to that of the last species. Soon after the larva settles the same two dorsal ridges of white secretion make their appearance, but soon split up into transverse bands. Examined on the fifth day after hatching, a larva showed seven distinct transverse bands, the anterior one being in the shape of a horseshoe. At the same time the lateral margin of the body was observed to be fringed with stiff spines, seventeen to a side. At nine days the small horseshoe-like mass had extended so as to nearly cover the thorax, and the transverse bands had lengthened and widened until they presented the appearance of a nearly complete shield to the abdomen, serrate at the edges. Fifteen lateral tufts, such as were noticed in *C. Floridensis,* and such as Targioni figures in the larva of *C. rusci* (Stud. Sul. coccinigliе, plate 1, fig. 6) had appeared, though still small.

At this stage of growth, as with the last species, all development seemed to stop, although the specimens lived on for months, the temperature in the breeding-room probably not being favorable to the formation of the plates.

The smallest specimen in the collection with the plates already formed measures 2 mm. long by 2 mm. wide and 1 mm. high. The color is light brown, and the wax has a somewhat translucent appearance. The dorsal plate is seven-sided; it is truncate anteriorly and pointed posteriorly. From each angle radiates a suture to the lateral edge, thus forming seven lateral plates, of which a single one is above the head, while above the anus is the suture between two. Through this suture projects the anal

spur. Each plate has a dark brown patch in its center, and in the center of each brown patch is a bit of the white secretion.

Habitat and food plants.— Found at Jacksonville and in Volusia County, Florida, on orange, quince, and on a species of Eupatorium, often in company with *C. Floridensis,* although it was by no means so common a species.

Genus **PULVINARIA** Targioni

The genus Pulvinaria is not well defined. It was erected for those species of Lecaninae in which the females after fecundation secrete below and at the posterior end of the body a mass of cottony material which forms a nidus for the eggs.

But one species has been described in this country — the *Pulvinaria innumerabilis* of Rathvon, a very abundant species in many localities upon the maples. It is figured upon Plate XI, figure 6. Interesting papers upon the species will be found in the Proceedings of the Davenport Academy of Sciences, volume ii, and in the American Naturalist, volume xii, page 655.

Genus **LECANIUM**

This species includes those species of Lecaninae which are naked and at first boat-shaped, taking on, however, after impregnation very diverse forms, from nearly flat to globular.

Signoret has divided the genus into six sections.

Those species which we shall consider may be placed in three of these sections, which are separated as follows:

1. Flat; the lobes of the body visible; generally viviparous. L. HESPERIDUM.
4. More or less globular, the skin with dermal cellules; tarsi truly articulated and antennae 8-jointed..... L. HEMISPHAERICUM.
5. Rugose, with dorsal carinae..... L. OLEAE.

LECANIUM HEMISPHAERICUM Targioni

(Plate VIII, fig. 3)

Adult female.— Shape approaching hemispherical with the edges flattened. Average length 3.5 mm., width 3 mm., height 2 mm. The shape and proportions vary somewhat according as the scale is formed upon a leaf or a twig. Upon the rounded twig it loses something of its hemispherical form, becomes more elongated, and its flattened edges are bent downwards, clasping the twig. In such cases, of course, its height becomes greater and its width less. The color varies from a very light brown when young to a dark brown, occasionally slightly tinged with reddish when old. The oval cells of the skin vary in length from .01 to .04 mm., and each cell contains a large granular nucleus. The antennae are 8-jointed with joints 1 and 2 short and thick; joint 3 is the longest, and the succeeding joints decrease gradually in length to joint 8, which is longer than the preceding. Occasionally a specimen is found in which joint 5 is longer than joint 4, and I have seen individuals in which this was the case with one of the antennae while the other was normal. The legs are long and rather slender; the bristle on the trochanter is long; the articulation of the tarsi is very well marked. (This fact has suggested to Signoret that the insects of this series are less fixed than their congeners.) The tarsal digitules are, as usual, two long and two short, those

of the claws spreading widely at summit, and very stout at the base. The anal-genital ring (more easily seen than in the other species we describe) is furnished with eight long hairs. The anal plates are triangular with rounded corners, and are furnished with two long hairs upon the disk, and three much shorter ones at the tip.

Egg.— The egg is ellipsoidal in form, and 0.15 mm. in length. In color it is whitish with a yellowish tinge, and is smooth and shining.

Newly hatched larva.— The antennae are only 7-jointed, and the tarsotibial articulation is hardly marked.

This bark louse was first noticed in the orangery of the department, upon the leaves and twigs. It was also noticed upon various greenhouse plants, Disipyrus, Chryosphyllum, sago palm, and *Croton variegatum.* Shortly after being found here it was received from correspondents in California as infesting orange and oleander. During my visit to California I found it upon a single orange tree in the yard of Mr. Elwood Cooper, near Santa Barbara.

Actual observation shows the surmise of Signoret as to the locomotive powers of this insect to have been correct. We have seen the adult insects when removed from their positions crawl back with apparent ease.

LECANIUM HESPERIDUM Linn.

(Plate VIII, fig. 2)

Adult female.— Length 3 to 4 mm. Color yellow, inclined to brown upon disk, often quite dark; shape, elongate oval, nearly flat; smooth and shining, with sparse punctures upon the disk; after death the border above often becomes wrinkled radially for narrow space. The antennae are 7-jointed, the fourth and seventh subequal in length and the third but little shorter; 1, 2, 5, and 6, short and subequal. The legs are long and comparatively slender, with the tarsi shorter by one-fourth than the tibiae; the hair upon the trochanter is very long, and the tarsal claw is large; the tarsal digitules are long and much widened at their extremities; and also stout at the base. The anal ring is very small and is furnished with six long stout bristles.

Young larva.— Long oval; antennae with six joints only, of which the third is the longest.

The male of this species has never been found, although it has been studied from the time of Linnaeus down. The species is viviparous. This is the commonest and most widely spread of any of the bark lice we have considered. In the United States we have received it from all quarters. Our notebooks show, for example, New York, District of Columbia, Georgia, Florida, Utah, California. All through the North it is to be found on greenhouse plants, and in the latitude of Washington and south it is found the year round on ivies, oranges, and other plants. In Europe Signoret speaks of finding it principally upon oranges, both in greenhouses and in the open air, but also states that it is found upon all surrounding plants.

We have no data concerning number of generations each year; in fact they are not well marked.

Three species of parasites have been reared from this bark louse, and all have been described in Mr. Howard's paper on parasites. The first, *Cocophagus cognatus,* from *Lecanium hesperidum,* on orange in Florida; the second, *Comys bicolor,* from scales on ivy at Washington; and the third, *Encyrtus flavus,* from orange scales in California.

LECANIUM OLEAE Bernard

THE BLACK SCALE OF CALIFORNIA

(Plate VIII, fig. 1)

Adult female.— Dark brown, nearly black, in color; nearly hemispherical in form, often, however, quite a little longer than broad; average length from 4 to 5 mm.; average height, 3 mm. Dorsum with a median longitudinal carina and two transverse carinae, the latter dividing the body into three subequal portions; frequently the longitudinal ridge is more prominent between the transverse ridges than elsewhere, thus forming with them a raised surface of the form of a capital H. The body is slightly margined; outer part of the disk with many (18 to 30) small ridges which extend from the margin halfway up to center of dorsum. Viewed with the microscope, the skin is seen to be filled with oval or round cells each with a clear nucleus; the average size of the cells being from .05 to .06 mm. in length, while the nuclei average .02 mm. in diameter. The antennae are long and 8-jointed, the two basal joints short; joint 3 longest, joints 4 and 5 equal and shorter, joints 6 and 7 equal and still shorter, joint 8 with a notched margin and almost as long as joint 3. Legs rather long and stout, the tibiae being about one-fifth longer than the tarsi. The anal ring seems to bear six long hairs.

Egg.— Long oval in shape, .04 mm. in length, yellowish in color.

Newly hatched larva.— There is nothing very characteristic about the young larvae; they are flat, and their antennae are only 6-jointed.

The black scale is stated by Signoret to be properly in France an olive scale, sometimes, however, becoming so common as to occur on all neighboring plants also. In California we find it infesting the greatest variety of plants, and becoming a very serious enemy to orange and other citrus trees. I have found it at Los Angeles on orange and all other citrus plants, on olive, pear, apricot, plum, pomegranate, Oregon ash, bittersweet, apple, eucalyptus, Sabal palm, California coffee, rose, cape jessamine, *Habrothmus elegans*; and elsewhere upon an Australian plant known as *Brachaeton*, and also upon a heath. It preferably attacks the smaller twigs of these plants, and the young usually settle upon the leaves.

The development of this species is very slow, and it seems probable that there is only one brood in a year. Specimens observed by Mr. Alexander Craw at Los Angeles, which hatched in June or July, began to show the characteristic ridges only in November. Mr. Craw has seen the lice, even when quite well grown, move from twigs which had become dry and take up their quarters on fresh ones.

Although carefully looked for, the males, like those of so many other lecanides, have never been found.

A dark brown bark louse has been sent me from Florida, on live oak, holly, oleander, orange, and one or two unknown plants, by Dr. R. S. Turner, of Fort George, which appears to be identical with *Lecanium oleae*. It is, however, by no means as abundant or injurious in that State as in California.

Natural enemies.— Enormous quantities of the eggs of the black scales are destroyed by the chalcid parasite *Tomocera californica*, described on page —— of this report. Particulars as to the work of this parasite are given at the same place. Upon one occasion (August 25, 1880), I found within the body of a full-grown female a lepidopterous larva, which was very similar in appearance to the larvae of the species of *Dakruma*

described in my last report as destroying bark lice. The specimen, however, was lost, and no more have been found since.

A number of beetles of the genus Latridius were found under scales which had been punctured by the Tomocera, but probably would not destroy the live insect. Many mites were found feeding upon the eggs and young. The infested trees were also swarming with the different species of ladybugs (Coccinellidae).

Subfamily COCCINAE

Genus **KERMES** Targ.-Tozz.

(Plate IX, fig. 1)

The following characterization of this genus is taken from Signoret: Body perfectly globular or with a slight incision for insertion on the twig or branch. On an external examination no trace of antennae, legs, or even mouth parts is to be observed, and the insect presents precisely the appearance of a gall.

In the larvae, however, the true characters of the Coccinae are seen — multiarticulate lower lip and the absence of the anal plates. The larval characters are the ones which have been principally used in the description of species as they are easy to find. They (the larvae) are long, oval, the abdomen plainly segmented and deeply cleft at the extremity, except in *K. vermilio* and *K. ballotae.* Upon each segment there are several spines at the lateral edge and several hairs upon each disk. The lateral lobes have each a bundle of spines and a very long hair. Antennae 6-jointed, joint 3 longest. With all the legs the tibiae are shorter than the tarsi. With the adult the antennae and legs appear natural; but in very old individuals, which have secreted the horny covering, the antennae are still present but deformed; so also with the legs, but the latter are sometimes entirely wanting.

The males resemble those of other Coccinae, and are inclosed in a little white felt-like sac. Head globular, with four eyes and six ocelli in *K. bauhinii* (the only species observed by Signoret). The antennae are very long, joint 3 longest, joint 10 shortest, and carrying several hairs with buttoned tips. Wings long. Abdomen long, with a short genital armature and two long bristles each side. Legs long, the tibiae longer than the tarsi, the latter with a long claw and the four ordinary digitules.

There are in the collection of the department several species belonging to this genus, which we have collected in Florida, Alabama, Louisiana, California, New York, and District of Columbia. For want of time I am unable to characterize these now. The species represented on Plate IX, figure 1, occurs on *Quercus* —— in California. The only North American species which has been described is *Kermes galliformis* Riley, described in the American Naturalist, volume xv, page 482 (June, 1881).

Genus **ERIOCOCCUS** Targ.-Tozz.

The following characterization of this genus is taken from Signoret: Species early inclosed in felt-like sac, soon after fecundation and before oviposition. At the posterior extremity of the sac is a minute opening probably for the exit of the young. The young larvae approach those of Kermes in appearance. They are more or less oval, rounded anteriorly, attenuated posteriorly; the lobes on each side of the anal ring highly developed. Upon the back are several distinct rows of spiny tubular spinnerets; these rows are altered in the adult to a considerable mass of

spinnerets. The antennae are 6-jointed in the female, 7 in the male larva, and 10 in the adult male. At the base of the antennae there is in some species an elongated tubercle. The males resemble those of Dactylopius. Some of the antennal joints are furnished with buttoned hairs. The balancer has but a single bristle. The stylet is very short.

ERIOCOCCUS AZALEAE, new species

THE AZALEA BARK LOUSE

Adult female.— Length of sac, 3 mm.; width 1.5 mm., the female herself being somewhat smaller. The sac is dense, pure white, and covered with protruding filaments of white secretion, especially in the younger individuals; it is nearly oval in form, somewhat pointed at both ends. The female removed from the sac is dark purple, almost black; its shape is that of the sac, more rounded anteriorly and pointed posteriorly; its color is dark purplish, almost black; it is almost entirely naked, only a very small amount of the cottony secretion occurring on the ventral surface near anus. The whole dorsal surface is covered with long stout acuminate yellow spines, and also between these spines with minute pointed tubercles; there are also numerous pores; the underside of the body is comparatively smooth, bearing a very few of the shorter spines. The antennae are 6-jointed, but the bulb when the specimen is pressed under the cover glass often takes on the appearance of an additional joint; joints 1, 2, and 3 are subequal in length, joint 1 being perhaps a trifle the shortest; joints 4 and 5 are less than half as long as 1, and are subequal; joint 6 is nearly as long as 3; joints 3, 4, and 5 have each one or more bristles; joint 6 several, none, however, appearing buttoned at tip. The tibiae are two-thirds as long as the tarsi; tarsal digitules very long and slender, the claw large and strong. The lower lip is indistinctly 3-jointed, the basal joint widening slightly, and the final joint triangular; there are four or five hairs upon the disk and two at the summit. The anal lobes are small, each surmounted at tip by a very long bristle, and each bearing dorsally three of the long tubular spines, two at base and the other on the mesal edge, little more than half way to tip; there is also a bristle on the ventral surface. Anal ring with eight hairs.

Egg.— Length 0.27 mm.; color reddish purple. We have counted 50 eggs in one sac, and 52 eggs and 12 larvae in another.

Young larva.— Color bright carmine, legs and antennae yellowish red. The large tubular spines of the adult are present, but in much smaller number, and are yellow in color. The antennae are plainly 6-jointed, with joint 6 longest.

The half-grown individuals are covered with a shaggy coat of filaments precisely similar to that covering the sac.

The sac containing the male is similar in all respects to that of the female, except that it is less than half the size and rather narrower in proportion to its length. No males have been bred.

Habitat.— On the twigs and stems of azalea in the department conservatories at Washington; quite abundant.

Natural enemies.— The majority of the specimens of *E. azaleae* collected were parasited by the chalcid *Coccophagus immaculatus* Howard, described farther on.

Genus **RHIZOCOCCUS** Signoret

This genus was erected by Signoret* to receive an insect (*R. gnidii*) which he found on the roots of *Daphne gnidium,* and which differs, according to his description, from the species of Eriococcus in no important anatomical character, except in the antennae of the female being 7-jointed. The specimens (female only) which Signoret studied were naked; but he had not sufficient material to ascertain if the insect makes a sac or not in its most advanced stage.

During the past year I have studied two bark lice which agree with the characters given for Eriococcus, except that the females have 7-jointed antennae, and remain naked until they are fully grown. These species I place provisionally in the genus Rhizococcus, and submit the following characters, drawn from the species described here, for that genus.†

Genus RHIZOCOCCUS

Antennae of larvae and of the adult female 7-jointed; ano-genital ring with eight hairs; tarsi of both male and female each with four digitales; margin of body of young and of female in all stages fringed with tubular spinnerets, which are covered with a waxy excretion; adult male with single ocellus behind each eye, and a pair of bristles on each side of penultimate abdominal segment, each pair supporting a long white filament excreted by numerous pores at its base. The fully developed female makes a dense sac of waxy matter within which the eggs are laid and the shriveled body of the insect remains; the full-grown male larva makes a similar sac within which it undergoes its metamorphoses.

RHIZOCOCCUS ARAUCARIAE (Maskell)

THE NORFOLK ISLAND PINE COCCUS

(Plate X, fig. 1)

Eriococcus araucariae Maskell. Transactions and Proceedings of the New Zealand Institute, vol. xi, p. 218.

During the summer of 1880, I found very common on the Norfolk Island pine (*Araucaria excelsior*) growing in open air in southern California, a bark louse, which is probably the species that was described in New Zealand by Mr. Maskell the year previous under the above name.

When a tree is badly infested with this pest it becomes blackened with a black fungus, which I presume is *Fumago salicina,* which accompanies coccids on orange and other trees. This is often the first indication of the presence of the insect which is observed. But when an infested tree

* Annales de la Soc. Ent. de France, 1875, p. 36.

† M. Signoret, to whom I referred specimens of *R. araucariae,* is of the opinion that this species is not congeneric with his *R. gnidii,* and he advised me to establish a new genus for the species on araucaria. The mode of life of the two species is certainly very different, *R. gnidii* living on the roots of a plant, and *R. araucariae* upon the leaves; and it seems probable that the former never makes a sac. But until more is known of *R. gnidii* or of some undoubtedly congeneric form, and structural differences between it and *R. araucariae* are discovered, I am unwilling to assume the risk of proposing an unnecessary generic name. In fact the great similarity between the species described here and those belonging to Eriococcus leads me to believe that it would be better to enlarge the characters of that genus so as to include species in which the antennae of the female are 7-jointed, and which are naked in their adolescent stages. The fact that it is sometimes difficult to decide whether an antenna is 6-jointed or 7-jointed (see description of *E. azaleae*) confirms this belief.

is carefully examined, numerous white cocoon-like sacs containing the full-grown insects may be seen closely applied to the sides or bases of the leaves. Frequently these sacs are so massed at the ends of the twigs that the bases of the leaves are completely covered. The immature insects are not so easily seen with the unaided eye, as they differ but little in color from the tree. They are greenish yellow, and are usually to be found in the angles formed by the bases of the leaves. The larvae of both sexes and the adult females are similar in form (Plate X, fig. 1*d*). The posterior end of the body is furnished with two prominent lobes, each terminated by a long hair. Between these lobes there is a conical mass of white waxy matter projecting backwards. The margin of the body is fringed with a row of tubular spinnerets. These spinnerets are more numerous on the adult female than on the larva; in both stages each one is covered with waxy matter, which often extends beyond the end of the spinneret. Excepting these filaments and the caudal tuft, but little excretory matter is to be seen; so that although the insect resembles a mealy bug in the form of its body it differs greatly in appearance. The female when full-grown measures 2.3 mm. (.09 inch) in length. When the female is ready to lay her eggs she excretes a cocoon-like covering to the body, composed of white waxen threads (Fig. 1). This sac is dense like felt, but easily torn; it is open on the middle line of the ventral surface or very much more delicate on that part. It adheres to the tree quite firmly, remaining where excreted after the death of the insect. As the eggs are laid, the body of the female shrinks away, making room for them, and finally it becomes a very small pellet in the anterior end of the sac, the remainder of the space being filled with eggs. These are light yellow in color. When the male larva is ready to undergo his metamorphoses, he secretes a covering to his body resembling the sac excreted by the female, except that it is very much smaller, measuring only 1.33 mm. (.05 inch) in length (Fig. 1). From this sac the adult insect emerges as a delicate fly-like creature, with two large wings and a pair of long waxen filaments projecting from posterior part of the abdomen; these filaments are very conspicuous, being white and longer than the body of the insect. (Plate X, fig. 1*a*.)

Color of body white with many irregular brown markings.

I have not sufficient data to ascertain the number of generations of this insect each year. August 27, I found specimens in all stages of development.

RHIZOCOCCUS QUERCUS, new species

(Plate X, fig. 2)

Female.— The tubular spinnerets are more numerous than in *R. araucariae*, and are not confined to the margin of the body but are distributed irregularly over the dorsum. They vary much in size and are curved and acuminate (Fig. 2*a*). Tarsi less than one-half as long as tibiae. Hair on trochanter nearly as long as femur.

Male.— I have only one specimen, which is much shriveled; this resembles *R. araucariae* except that the ocelli are placed farther caudad of the eyes than in that species.

Described from 17 females, 1 male, and very many larvae, all mounted in balsam.

Habitat.— On scrub oak at Rock Ledge, Fla.; upon gall berry, oak, and grass at Fort George, Fla. (Dr. R. S. Turner). The sacs (Fig. 2) of this species, of which I have very many specimens, very closely resemble those of *R. araucariae*. The sacs of the female are all large, indicating that the species is naked till full-grown.

Genus **DACTYLOPIUS**

To the genus Dactylopius belong the insects commonly known as mealy bugs. The antennae of the female are 6-jointed in the larva, and 8-jointed in the adult; the male larva has 7-jointed antennae. The tarsi are furnished with four digitules and the anal ring with six hairs.

DACTYLOPIUS ADONIDUM (Linn.) Signoret

THE COMMON MEALY BUG

(Plate XI, fig. 1)

Coccus adonidum Linn. Syst. Nat. (1767), 740, 4.
Dactylopius adonidum Signoret. Ann. de la Soc. Ent. de France, 1875, p. 306.

Under the specific name of *adonidum* have been classed the various species of "mealy bugs," common in greenhouses throughout the civilized world. It would be difficult, if not impossible, to determine beyond a doubt the particular form to which Linneus gave this name, more than one hundred years ago. Consequently the best course to follow is to accept the conclusions of Signoret, who has given this genus the most careful study that it has yet received. The following is the description of the species to which he applies the name given by Linneus:

The *female* is 2½ to 3 mm. (.1 to .12 inch) in length, and 1.5 mm. (.06 inch) in width; white, a little yellowish, with a brown band upon the middle of the back, the legs and the antennae a little brownish, powdered with a great quantity of floury matter secreted through pores scattered over the body; in addition to this, each lateral lobe or segment presents a secretion which forms a border of woolly appendages around the body varying in length; those near the posterior end of the body are longer, and four at the abdominal extremity are very long; the two internal ones are longest, equaling and sometimes surpassing the length of the body. The antennae are composed of eight points, of which the eighth is the longest, and the third and the second, fourth, and fifth the shortest and of equal length; sixth and seventh a little longer than the fourth and fifth. The antennae are slightly pubescent, especially at the summit of each joint. The legs are quite long, slightly pubescent, the tibia twice as long as the tarsus; claw strong and long, with the digitules slender and furnished with a very little knob. The abdomen presents upon the suture of the first and of the second segment and upon the median line a cicatrice more or less visible and more or less rounded; upon the suture of the fourth and fifth, on each side, nearer the margin than the median line, an oblong cicatrice; upon each segment, a great quantity of pores in the form of rounded points and some scattered hairs. Each lateral lobe presents a space with rounded pores, then two conical spines more or less strong; this is the apparatus secreting the cottony matter of which is formed each lateral appendage; the lobes of the extremity of the body have many more pores, and the conical spines are much larger; a little lower down arise two hairs, one of which is large; around these is condensed the secretion furnished by the pores. The anal ring is very large, dotted, and has six quite long hairs.

The *larva,* varying in size according to its age, is more flat, of the same elongated form, and of the same color, but differs in the antennae, which have only six joints. Other individuals, of a uniform shape and more elongated, have 7-jointed antennae; these are the males which are to undergo another molt, which very often is indicated by the rolling up of the oval setae and sometimes by the future antennae and legs,

which are already indicated within the members of the larva. In this type the tibia is hardly one-third longer than the tarsus.

The *male* we bred from larvae with 7-jointed antennae; in order to undergo their metamorphoses, they form little cottony sacs. The adult is long, of a brown, neither yellow nor red, with the segmentations paler. As it becomes older it grows darker, especially upon the head and the corneous pieces of the thorax. The wings are long, largely rounded, of a gray more or less deep, reddish towards the side. The poisers are long, yellow, with a single bristle hooked at the extremity. The prothorax is long, rounded upon the sides, straight in front, rounded behind, with a black arc upon the mesothorax. The abdomen is long, terminated by a rounded armature, thick, presenting some hairs. The lateral lobes of the last segment present two long threads of white cottony matter, secreted by numerous rounded pores; in the middle of each lobe are two long hairs and one smaller, around which the matter is condensed; the lobes above present much smaller ones, with two or three rounded pores. The head is thick, in the form of a ball a little truncated in front, more convex below than above, and pubescent, except upon the pigmentary circle of the eyes and ocelli. We have not determined exactly the number of the ocelli, which we think is four. The legs are long, with a large tarsus, flat, pubescent, presenting a very long and narrow claw. We have not been able to see the digitules of the claws. As to those of the tarsi, they are not larger than ordinary hairs with a very little knob at the extremity.

We have reproduced the figures of this species given by Dr. Signoret (Plate XI, fig. 1): 1, lateral lobe of the extremity of the abdomen of the female; 1*a*, antenna of the female; 1*b*, antenna of the male; 1*c*, leg with the four digitules of the female; 1*d*, anal ring with six hairs.

DACTYLOPIUS DESTRUCTOR, new species

THE DESTRUCTIVE MEALY BUG

(Plate XI, fig. 3; Plate XXII, fig. 2)

Adult female.— Length 3.5 to 4 mm.; width 2 mm. Color dull brownish yellow, somewhat darker than with *D. longifilis*; legs and antennae concolorous with body. The lateral appendages (seventeen on each side) are short and inconspicuous and are subequal in length. Upon the surface of the body the powdery secretion is very slight. In spite of the small size of the filaments, the spinnerets and the supporting hairs are as numerous and as prominent, or nearly so, as in *D. longifilis*; those upon the anal lobes being especially long. Antennae 8-jointed; joint 8 is the longest and is twice as long as the next in length, joint 3. After 3, joints 2 and 7, subequal, then 5 and 6, joint 4 being the shortest. The tarsi are a little more than half the length of the tibiae and the digitules are as in the preceding species; claws strong.

Egg.— Length 0.25 mm.; shape rather long, ellipsoidal; color light straw yellow.

Young larva.— Rather brighter-colored than the egg. Antennae 6-jointed with the female, with the same relative proportions as in the preceding species. Tarsi considerably longer than the tibiae. The lower lip is large, conical, and reaches almost to the posterior coxae.

Male.— Length 0.87 mm.; expanse of wings, 2.5 mm. Color light olive-brown, lighter than in following species; legs concolorous with body; antennae reddish; eyes dark red; bands darker brown than the gen-

eral color; anterior edge of mesoscutum and posterior edge of scutellum darker brown. Body, as will be seen from measurements, rather small and delicate compared with the size of the wings; head small, with almost no hair; antennae 10-jointed, joints 3 and 10 longest and equal; joints 2, 6, 7, 8, and 9 nearly equal and considerably shorter than 3 and 10; joints 3 and 4 subequal and a trifle shorter than the following joints. The lateral ocelli are each just laterad of the center of the eye, and not at its posterior border, as in the following species. (This, however, is a character which will not hold with specimens long mounted.) Prothorax short; legs sparsely covered with hairs; tarsal digitules extremely delicate, and the button is very difficult to distinguish; we have been unable to discover a trace of the pair belonging to the claw. The anal filaments and the supporting hairs are similar to those of the following species.

This species is readily distinguished from *D. longifilis* by the shortness of the lateral and anal filaments in the female. Indeed, for convenience's sake, we have been in the habit of distinguishing them as the mealy bug with short threads and the one with long. The life history of this species differs quite decidedly from that of *D. longifilis,* in that true eggs, which occupy quite a long time in hatching, are deposited. The female begins laying her eggs in a cottony mass at the extremity of her abdomen, some time before attaining full growth, and the egg mass increases with her own increase, gradually forcing the posterior end of the body upwards until she frequently seems to be almost standing on her head. The young larvae soon after hatching spread in all directions and settle — preferably along the midrib on the under side of the leaves, or in the forks of the young twigs, where they form large colonies, closely packed together. As mentioned in the description, they are only slightly covered with the white powder, and many seem to be entirely bare, with the exception of the lateral threads.

Habitat.— This species is very abundant upon almost every variety of house plant in the department greenhouses, but especially so upon the Arabian and Liberian coffee plants. On these plants they were found, curiously enough, in small pits or glands on the under side of the leaf, along the midrib. Almost every pit, of which there is one at the origin of each main vein, contained one or more young mealy bugs, and the larger ones whole colonies. The name *destructor* is, however, proposed for this insect from the damage done by it to orange trees in Florida, especially at Jacksonville and Micanopy, where it is the most serious insect pest of the orange.

Natural enemies — The chalcid parasite *Encyrtus inquisitor* Howard, described in this report, was bred from a specimen of this mealy bug collected at Jacksonville, Fla. A small red bug was observed by myself and several of our correspondents to prey upon the mealy bug. The larvae of another species have been found, but the mature form has not been obtained. These last have the faculty of changing color quickly from red to brown.

The very curious larvae of a ladybird beetle, known as *Scymnus bioculatus,* were found feeding upon the eggs of the mealy bug at Orange Lake. These larvae mimic the Dactylopii so closely that they might easily be taken for them. They are covered by a white secretion, and from each segment exudes a white substance which forms long filaments like those of the mealy bug. Removing the powder the larvae are seen to be yellow in color, with two roundish dusky spots on the dorsum of each thoracic segment. Each segment of the body is furnished laterally with one long bristle and a number of small ones.

DACTYLOPIUS LONGIFILIS, new species

THE MEALY BUG WITH LONG THREADS

(Plate XI, fig. 2; Plate XXII, fig. 1)

Adult female.— Length 4 to 5 mm.; width 2 mm. Color very light dull yellow, legs and antennae a trifle darker. Body rather sparsely covered with a whitish powder. The lateral appendages, numbering seventeen on each side, are long, the two posterior ones on each side very long — equaling if not surpassing in length the whole body. Antennae 8-jointed; joint 8 longest, then 3, and then 2, the difference being slight; joint 5 is next in size, and 4, 6, and 7 are nearly if not quite equal. The tarsi are only one-third as long as the tibiae. The four tarsal digitules are present and are knobbed; those of the claw are short and thick (although by no means so much so as in Lecanium), and the others very slender, and with a very delicate knob. Antennae, tarsi, and distal ends of tibiae quite hairy. Along the lateral edge of the body are many tubercular spinnerets, in which large tubes can be seen running to the tips. Below these spinnerets, on each lobe, is a pair of sharp conical spines, and several longer or shorter hairs. The conical spines upon the last two segments are much larger than those upon any other. The anal lobes bear each a long hair. The anal ring is prominent, and bears the customary six large tubular hairs.

Larva.— In color similar to the adult. Antennae 6-jointed, the sixth joint longest — as long as the three preceding joints together; the others short and subequal. In the male larva the antennae are 7-jointed. The tarsi somewhat longer than the tibiae.

Male.—Wing expanse, 2.6 mm.; length of body, 1.3 mm. Color light olive-brown; antennae and legs darker brown; band slightly darker than the general color; anterior border of mesoscutum and posterior edge of postscutellum dark brown; eyes dark red; wings slightly dusky, with a faint bluish tinge. Body long and stout; head large, and strongly pilose behind the eyes. Antennae 10-jointed; joint 3 longest, joint 6 next; joint 10 a trifle longer than 9, and about the same length as 7 and 8. Prothorax very long; legs very hairy; only two tarsal digitules are to be seen, those of the claw being rudimentary; they are short, very delicate, and with an extremely delicate button. Anal lobes each with long filaments, which when the wax is removed show two long supporting hairs and one short one. The visible ocelli are seen just behind the lateral angle of the eye, on each side.

This species is one of two which are very common in the department greenhouses, and seems to be more abundant upon the ferns and the plants of the euphorbiaceous genus Croton than upon any others. The female is very active when disturbed, and is not found with the cottony egg mass to be seen with many species of Dactylopius. The young is born enveloped in a thin pellicle or pseudovum, which splits a few moments after birth and allows it to escape. The female surrounds herself with the cottony material, and the young cluster around and under the mother for some time. The growth is evidently quite rapid, and individuals of all stages are to be found at almost any time. The male larva, some time before pupation, forms for itself a little cottony sac or cocoon, in which it undergoes its transformations.

Genus **PSEUDOCOCCUS** Westwood

This genus is very near Dactylopius, and nearly all the characters are identical. In the adult female, however, the antennae are 9-jointed, those of the female larvae being 6-jointed and of the male larvae 7-jointed. The tarsi are not provided with the customary long digitules except in *Pseudoccus hederae.*

PSEUDOCOCCUS ACERIS (Geoffrey)

This species, stated by Signoret to be one of the most common in France, would seem to be comparatively rare in the United States. It has been collected by Miss Emily Smith on maple (*Acer saccharinum*) at Peoria, Ill., and forms the subject of quite an extremsive article by her in the North American Entomologist, volume 1, page 73 (April, 1880). She also notes its occurrence at Lancaster, Pa., where it has been collected by Dr. Rathvon. The following description of the species is compiled from Signoret and Miss Smith:

Adult female.— Color, bright yellow (Smith), reddish yellow (Signoret). Length from 4 to 5 mm. Shape rounded oval, as large behind as in front. The dorsal integument is smooth, with the divisions into segments obscure; it is filled with spinnerets in the form of pores, and is also furnished with many delicate hairs, especially numerous upon the median part of each segment and at the extremity of the abdomen. The antennae are long and delicate, 9-jointed, second and third longest, the others diminishing in size and length except joint 9, which is longer than the preceding joint and acuminate at tip. The under lip is long, acuminate at tip, which is furnished with many hairs. The tibiae are nearly three times as long as the tarsi. The tarsal claws are rather short and toothed on their inner side, sometimes truncate at tip; there are only two digitules, those of the claw, the others being only simple hairs. The anal genital ring is large, punctated, and supports six quite long hairs.

Egg.— The egg is light yellow in color when first deposited, later becoming yellow-brown. Dimensions given by Miss Smith, 5 to 6 mm. long and 3 to 4 mm. wide; probably 0.5 to 0.6 mm. by 0.3 to 0.4 mm.

Young larva.— Color reddish yellow; shape elongated oval, narrow behind. Antennae 6-jointed, joint 6 as long as the three preceding joints together. The lower lip is 2-jointed. The body is surrounded by a series of spines and upon the disk of each segment is a series of eight tubercular spinnerets, with which alternate short hairs; in front of the head between the eyes are several longer hairs. The anal ring with six hairs; the lateral lobes large, each with one very long hair and several shorter ones. The tarsi a third longer than the tibiae.

The male larva is red and has 7-jointed antennae.

Male.— Color red. Antennae 10-jointed; joint 1 short and stout; joint 2 twice as long as 1; joint 3 three times as long as 1; joints 4 to 10 similar in size and form, decreasing slightly in length. Legs hairy; tarsi one-half as long as tibiae. Anal filaments longer than all the rest of the insect.

Genus **COCCUS**

In general appearance the genus Coccus resembles the foregoing considerably, but may be distinguished by the following characters:

The antennae are 7-jointed with the adult female, 6-jointed with the female larva, and 5-jointed with the male larva. The legs are very

slender. The anal ring is destitute of hairs. The eyes are smooth and there are two ocelli, this last character separating the genus from the following divisions.

COCCUS CACTI

THE COCHENILLE INSECT

The following description is taken from Signoret:

Adult female.— Dark reddish brown in color. From 6 to 7 mm. long, 4 mm. wide, and from 2 to 3 mm. high. Covered with a large quantity of white cottony powder; when this substance is removed it is seen to be strongly segmented, prismatic in form, in consequence of a dorsal carina, especially visible in dried specimens, and truncate behind, which gives it the form of a lance head. The antennae are short, conical, 7-jointed, the four basal joints short, thicker than long, joint 5 as long as thick, joint 6 a little longer, with a whorl of short hairs, joint 7 as long as the two preceding together, with ten or eleven short hairs.

Larva.— In the newly hatched female larva the antenna is 6-jointed, slender, joint 2 very short, 3 longer, but it soon becomes deformed and thick, even in the larva state. There are other larvae in which the antennae only seem to show five joints, the second having blended with the third; there is also another type of larvae which show only five joints. These differences indicate different states, either of the newly hatched larvae or of the female or male larvae. For these last we take those in which the legs are very slender and the antennae of which, seen upon the cast skin, show a very short basal joint, a second five times as long, the third and fourth short, and the fifth longest of all and a little slenderer.

The legs also vary according to the age and sex. In the old individuals they become short, thick, and often with very indistinct joints; when not deformed they are generally thick, with the tarsi longer than the tibiae in the larva, and almost as long in the old female. In the male larvae the legs are slenderer, with the tarsal claws very long and accompanied by the four-buttoned digitules. The skin is smooth, with groups of spinnerets here and there and a few scattered hairs. The newly hatched larva is oval, larger before than behind; the antennae and legs are long; upon the lateral edge of each segment are two spines, a line of hairs each side of the median line, and a group of spinnerets near the lateral spines; between the double median line and the lateral spine is another simple line of short hairs.

Male.— The male is of a reddish yellow, darker upon the head and thorax, with brown legs and antennae, and light gray wings. The head is thick, rounded, acuminate between the antennae, with four smooth eyes and two ocelli. The antennae are 10-jointed, with the fourth, fifth, and tenth longest, all joints furnished with a short pubescence, the hairs of which appear truncate; at the tip of the fifth and last joints is a much longer pubescence formed of buttoned hairs; joints 1 and 2 almost smooth, showing but one or two hairs (this is a character seen in no other genus). The legs are very long, with a sparse pubescence formed of little hairs scattered over the disk and upon the sides; the tarsus is a third shorter than the tibiae and furnished with two very long digitules; the claw is very slender and very long, with its two digitules extending a little beyond it. The abdomen, paler in color, is furnished upon each side with a transverse line of small hairs; the lateral lobes of the extremity each with a protuberance covered with many spinnerets, and

at its end furnished with three hairs which support the waxy matter of the two caducous filaments, which are twice as long as the body of the insect. Between the two filaments is the copulating armature, composed of a very large tubercle, accompanied by a stylet shaped like a ventrally curved claw. Upon the middle of the abdomen is sometimes seen a small brown spot which forms a longitudinal band. Upon the prothorax anteriorly is a darker transverse band as well as upon the meso and metathorax, and sometimes three longitudinal bands from the neck to the metathorax. Ventrally, the framework of the sternum is browner. Although several individuals have been examined, we (Signoret) have never seen any balancer. The wings extend for a third of their length beyond the abdomen, and are widely rounded at the extremity; the nervures are brownish yellow with a reddish tint towards the body.

The cochenille insect of commerce, although an indigene of Mexico, has been imported into various other countries and is cultivated notably in the Canary Islands, in Algiers, and in Spain. Specimens from China seem, according to Signoret, to be but varieties of this species. Specimens of what is probably this species were collected by Dr. R. S. Turner at Fort George, Fla., upon a yellow flowering cactus; species unknown.

Genus **ICERYA** Signoret

Antennae 11-jointed; body covered by a cottony matter of several shades of color and with a secretion of still longer filaments. Skin with rounded spinnerets and with long scattered hairs. Antennae of nearly the same size throughout their whole length and with a long pubescence. The digitules of the claw elongated and buttoned; of the tarsus as simple hairs. Genital apparatus terminating in a tube internally with a reticulated ring like a sphincter and without hairs at its extremity. Antennae of the larvae 6-jointed with a very long pubescence, and with four hairs upon the last joint much longer than the others. Lateral lobes of the extremity of the abdomen with a series of three very long, frequently interlaced bristles.

ICERYA PURCHASI Maskell

(Plate IX, fig. 2)

Adult female.— Length 4 to 8 mm. Color dark orange-red, legs and antennae black, dorsal surface more or less covered with a white or yellowish white powder. The large egg sac is tinged with yellow and is longitudinally ribbed; it is a little longer than the whole body of the insect, and is filled with a loose white cottony mass containing the eggs. Over the whole surface of the body the skin is filled with circular spinnerets, each containing several openings; body clothed with short black hairs, dense at the margin of the body, forming tufts, and absent from the ventral side of the abdomen. Tarsi two-thirds the length of the tibiae; digitules of the claw very delicate and slender, and buttoned at tip.

Egg.— Red in color, true oval in shape, 0.7 mm. long.

Newly hatched larva.— Reddish, inclining to brown, in color. Antennae 6-jointed, joint 1 short and thick, joints 2, 3, 4, and 5 longer, slenderer, subcylindrical, and subequal, joint 6 larger and club-shaped. (There is sometimes an additional joint between 5 and 6.) All the joints except 1 with a few hairs; joint 6 with several, of which four are very long. Legs long and slender; tibia and tarsus with several long hairs; digitules of the tarsal claw proportionately much larger

than in the adult, bent like hooks, and buttoned at tips; tarsal digitules represented by simple hairs. The six anal bristles are very long and conspicuous, each arising from a quite prominent tubercle. Six longitudinal rows of spinnerets are seen upon the dorsum, two rows sublateral and the other four more nearly in the middle. These rows soon become confused, and are no longer distinguishable after the larvae have become somewhat grown. Alternating with the spinnerets are rows of hairs.

As the larva grows its appearance gradually changes. The outline, still oval, becomes more irregular, and its color is of a darker red, nearly brown. The six anal hairs become shorter until they are indistinguishable from the other hairs of the body, which become more abundant, especially on the abdomen, where the lateral tufts of the adult begin to appear early.

The young larva soon begins to excrete tufts of a yellow waxy matter along the dorsal surface of the body and the lateral margins. The excretion on the dorsum consists of four pairs of large tufts, while along the margin is a simple row of poorly defined smaller tufts. Between the dorsal and lateral excreted masses the body is naked, thus leaving on each side a bright red line, which contrasts strongly with the yellow excretion. Ventral surface of the body naked. From a row of large spinnerets, around the lateral edge of the body, project long delicate semi-transparent filaments, and from between the posterior pair of dorsal tufts there projects a long white waxy filament (often 10 mm. or more in length), on the end of which is usually a drop of clear fluid. This filament is very brittle, so that a slight jar will cause nearly every one on a tree to break.

The insects seem first to settle upon the leaves, preferably along the midrib, and afterwards to migrate to the twigs and branches, or even the trunk.

Habitat.— I found this species first during the summer of 1880, in a grove of 130 lime trees, owned by Mr. W. W. Stowe, at Santa Barbara, Cal. The trunks and limbs were in many cases so completely covered as to appear white, the leaves were turning yellow, and the tree was apparently dying. They had spread to surrounding orange orchards and I learn this year from Mr. G. W. Coffin, of the same place, that they are spreading with amazing rapidity.

It seems probable that it is an Australian species. The specific name which we have adopted was given this insect by Mr. Maskell, in the Transactions and Proceedings, New Zealand Institute, volume xi, page 221. It was found on a hedge of kangaroo acacia in Auckland, New Zealand, in great numbers, but upon that single hedge alone.

It is the same insect spoken of by Professor Riley, in the department report for 1878, under the name of *Dorthesia characias* Westw., where he stated that it had recently been imported into South Africa from Australia, and had become such a scourge as to attract the attention of the government. The first published notice of its appearance in this country which we have been able to find is in the California Agriculturist and Artisan for December, 1877, by Dr. A. W. Saxe, of Santa Clara, who stated it as his belief that the pest was originally brought from Australia on some plants imported by Mr. George Gordon, of Menlo Park, in 1868; and that it spread all along the coast counties. In the same article a letter from Dr. H. Behr, of San Francisco, identifies it as a species of Dorthesia.

Dr. Hagen, of Cambridge, Mass., informs me that he has seen the same species in greenhouses at Cambridge.

Genus **ORTHEZIA** Bosc.

Adult female.— Antennae 8-jointed, joints 2 and 8 longest, then 3, 4, and 5 almost equal, then 6 and 7 smaller and subequal, joint 1 thick and short, as wide as long. Legs of medium size, with the tarsi nearly half the length of the tibiae. Claw medium, with a small hair at the base on each side; no digitules on the tarsus. The body is of an elongate oval, strongly rounded behind, constricted in front, emarginate at the base of the antennae, rounded at apex, anal-genital ring large and with six hairs. The whole body in all stages covered with a calcareous laminated secretion, which, with the adult female, becomes more elongated posteriorly and forms a sac containing the eggs mixed with a fine down. Later, when the young are born, they remain in the sac until they have themselves secreted a sufficient amount of the lamellar material to cover them. This secretion is formed by hair-like spinnerets, scattered in considerable number over the whole surface of the body, and much more abundant in the perfect insect than in the larva.

Newly hatched larva.— Elongate oval, rounded in front, narrow behind. Antennae 6-jointed, joint 6 longest, a little longer than 4 and 5 together; joint 3 next to the longest. Legs and mouth parts well developed, the latter extending beyond the anterior border and having the appearance of being upside down.

Female larva.— Longer, with the sides more nearly parallel. Antennae 7-jointed, joint 7 very long, joint 3 next, joint 4 shortest; joint 7 ends in a short obtuse hair and bears eight short spine-like hairs, and, near the middle, a stronger obtuse hair. The legs are as usual, tarsi almost as long as tibiæ, pubescent.

Male larva.— What we consider (with some doubt, however) to be the male larva, is rounded, oval in shape, and is remarkable for the peculiarities of its antennae. The basal joint is very large and very long, and at its tip the rest of the antennae makes a bend. Joint 2 is almost as long as 1 but much slenderer, and bears four hairs upon its distal end and two smaller ones upon its disk; joints 3, 4, 5, and 6 are smaller and subequal, each one broadening at tip and bearing two small hairs; joint 7 is the longest of all, is a little bent, bears a very long hair at the tip, a little below it is a much smaller one, and two on each side.

Male.— Very long, with multiple eyes. The antennae are very long, filiform, each joint up to 9 with a swelling at tip; joints 1 and 2 very small, 3 very long, 4 to 8 a third shorter, subequal, 9 shorter still; all joints with a short pubescence. Thorax very long; wings a little acuminate at tip. Abdomen enlarged in the middle, bearing along each side a line of hairs, and upon the penultimate segment a band of tubular hairs which secrete a transparent caducous material. Legs long, pubescent, with a very long claw. Sexual apparatus large, forming about one-fifth the length of the abdomen.

In the collection of Professor Uhler are a number of specimens of a species of Orthezia labeled "Canada" and "Grimsby, Ontario." One specimen bears the label "On Golden Rod." These specimens seem, on superficial examination, to be specifically identical with a type specimen of Walker's *Orthezia americana*, which is also in Professor Uhler's collection. I have found immature specimens of what may be the same species upon the common burdock (*Arctium officinale*) at Ithaca, N. Y. (Plate IX, fig. 3.)

EXPLANATION OF PLATES

PLATE III (Original)

FIG. 1.—*Aspidiotus aurantii* Maskell. 1, Scales on leaves of orange, natural size; 1*a*, adult male, much enlarged; 1*b*, scales of female, enlarged; 1*c*, scale of male, enlarged.

FIG. 2.—*Aspidiotus ficus* (Riley MSS.). 2, Scales on leaves of orange, natural size; 2*a*, scale of female, enlarged; 2*b*, scale of male, enlarged; 2*c*, young larva; 2*d*, 2*e*, and 2*f*, different stages in the formation of the scale.

PLATE IV (Original)

FIG. 1.—*Aspidiotus nerii* Bouché. 1, Scales on leaves of acacia, natural size; 1*a*, adult male, enlarged; 1*b*, scale of male, enlarged; 1*c*, scale of female, enlarged.

FIG. 2.—*Ceroplastes Floridensis* n. sp. 2, Adult and young females on ilex, natural size; 2*a*, young female, enlarged; 2*b*, adult female, enlarged.

FIG. 3.—*Ceroplastes cirripediformis* n. sp. 3, Adult females, natural size; 3*a*, female, enlarged.

PLATE V (Original)

FIG. 1.—*Diaspis rosae* (Sand.). 1, Scales on rose, natural size; 1*a*, scale of female, enlarged; 1*b*, scale of male, enlarged.

FIG. 2.—*Diaspis carueli* Targ.-Tozz. 2, Scales on juniper, natural size; 2*a*, scale of female, enlarged; 2*b*, scale of male, enlarged.

FIG. 3.—*Chionaspis euonymi* n. sp. 3, Scales on euonymus, natural size; 3 *a*, scale of male, enlarged; 3*b*, scale of female, enlarged.

PLATE VI (Original)

FIG. 1.—*Chionaspis furfurus* (Fitch). 1, Scales on pear, natural size; 1*a*, scale of male, enlarged; 1*b*, adult male, enlarged; 1*c*, scale of female, enlarged.

FIG. 2.—*Chionaspis pinifoliae* (Fitch). 2, Scales on *Pinus strobus*, natural size, leaves stunted; 2*a*, leaves of *P. strobus* not stunted by coccids; 2*b*, scale of female, usual form, enlarged; 2*c*, scale of female, wide form, enlarged; 2*d*, scale of male, enlarged.

PLATE VII (Original)

FIG. 1.—*Mytilaspis citricola* (Pack.). 1, Scales on orange, natural size; 1*a*, scale of female, dorsal view, enlarged; 1*b*, scale of female with ventral scale and eggs, enlarged; 1*c*, scale of male, enlarged.

FIG. 2.—*Mytilaspis Gloverii* (Pack.). 2, Scales on orange, natural size; 2*a*, scale of female, dorsal view, enlarged; 2*b*, scale of male, enlarged; 2*c*, scale of female with ventral scale and eggs, enlarged.

PLATE VIII (Original)

FIG. 1.—*Lecanium oleae* Bernard. 1, Adult females on olive, natural size; 1*a*, female, enlarged.

FIG. 2.—*Lecanium hesperidum* Linn. Adult females on orange, natural size.

FIG. 3.—*Lecanium hemisphaericum* Targ. 3, Adult females on orange, natural size; 3*a*, adult female, enlarged.

PLATE IX (Original)

FIG. 1.—*Kermes* sp., on *Quercus agrifolia*. Adult females on stem; immature males on leaves.

FIG. 2.—*Icerya purchasi* Maskell. Females, adult and young, on orange.

FIG. 3.—*Orthezia* sp.

PLATE X (Original)

FIG. 1.—*Rhizococcus araucariae* (Maskell). 1, Sacs of male and female on Norfolk Island pine, natural size; 1*a*, adult male, enlarged; 1*b*, caudal extremity of male with excretion removed. 1*c*, the same of female; 1*d*, adult female, enlarged; 1*c*, tarsus of male, showing digitules; 1*f*, leg of female; 1*g*, spinnerets of female; 1*h*, antenna of female.

FIG. 2.—*Rhizococcus quercus* n. sp. 2, Sacs of male and female on *Quercus virens*, natural size; 2*a*, spinnerets of female, enlarged; 2*b*, leg of female, enlarged.

PLATE XI (Original except Fig. 1)

FIG. 1.—*Dactylopius adonidum* Linn. (after Signoret). 1, Lateral lobe of the abdominal extremity of female; 1*a*, antenna of female; 1*b*, antenna of male; 1*c*, leg of female; 1*d*, anal ring with six hairs.

FIG. 2.—*Dactylopius longifilis* n. sp. Female, enlarged.

FIG. 3.—*Dactylopius destructor* n. sp. Female, enlarged.

FIG. 4.—*Parlatoria pergandii* n. sp. 4*a*, scale of female, enlarged; 4*b*, scale of male, enlarged.

FIG. 5.—*Parlatoria zizyphi* Lucas. Scale of female, enlarged.

FIG. 6.—*Pulvinaria* on grape. Female, natural size.

FIG. 7.—*Fiorinia camelliae* n. sp. Scale of female, enlarged.
FIG. 8.—*Chionaspis quercus* n. sp. Scale of female, enlarged.
FIG. 9.—*Asterodiaspis quercicola* (Bouché). Enlarged.
FIG. 10.—*Mytilaspis* [———].

PLATE XII (Original)

FIG. 1.—*Aspidiotus aurantii* Maskell.
FIG. 2.—*Aspidiotus ficus* (Riley MSS.).
FIG. 3.—*Aspidiotus perseae* n. sp.
FIG. 4.—*Aspidiotus obscurus* n. sp.
FIG. 5.—*Aspidiotus tenebricosus* n. sp.
FIG. 6.—*Aspidiotus rapax* n. sp.
FIG. 7.—*Aspidiotus perniciosus* n. sp.
FIG. 8.—*Aspidiotus convexus* n. sp.

PLATE XIII

FIG. 1.—*Aspidiotus aurantii* Maskell.
FIG. 2.—*Aspidiotus ficus* (Riley MSS.).
FIG. 3.—*Aspidiotus perseae* n. sp.
FIG. 4.—*Aspidiotus obscurus* n. sp.
FIG. 5.—*Aspidiotus tenebricosus* n. sp.

PLATE XIV

FIG. 1.—*Aspidiotus cydoniae* n. sp.
FIG. 2.—*Aspidiotus juglans-regiae* n. sp.
FIG. 3.—*Aspidiotus ancylus* Putnam.
FIG. 4.—*Aspidiotus uvae* n. sp.

PLATE XV

FIG. 1.—*Aspidiotus nerii* Bouché.
FIG. 2.—*Aspidiotus* (?) *pini* n. sp.
FIG. 3.—*Diaspis carueli* Targ.-Tozz.
FIG. 4.—*Diaspis ostreaeformis* Curtis.

PLATE XVI

FIG. 1.—*Aspidiotus uvae* n. sp.
FIG. 2.—*Aspidiotus* (?) *pini* n. sp.
FIG. 3.—*Chionaspis furfurus* (Fitch).
FIG. 4.—*Chionaspis pinifoliae* (Fitch).
FIG. 5.—*Chionaspis salicis* (Linn.).
FIG. 6.—*Chionaspis ortholobis* n. sp.

PLATE XVII

FIG. 1.—*Diaspis rosae* (Sand.).
FIG. 2.—*Chionaspis euonymi* n. sp.
FIG. 3.—*Chionaspis furfurus* (Fitch).
FIG. 4.—*Chionaspis nyssae* n. sp.

PLATE XVIII

FIG. 1.—*Chionaspis pinifoliae* (Fitch).
FIG. 2.—*Chionaspis quercus* n. sp.
FIG. 3.—*Mytilaspis citricola* (Pack.).
FIG. 4.—*Mytilaspis Gloverii* (Pack.).

PLATE XIX

FIG. 1.—*Chionaspis ortholobis* n. sp.
FIG. 2.—*Mytilaspis pomorum* Bouché.
FIG. 3.—*Parlatoria pergandii* n. sp.
FIG. 4.—*Fiorinia camelliae* n. sp.

PLATE XX

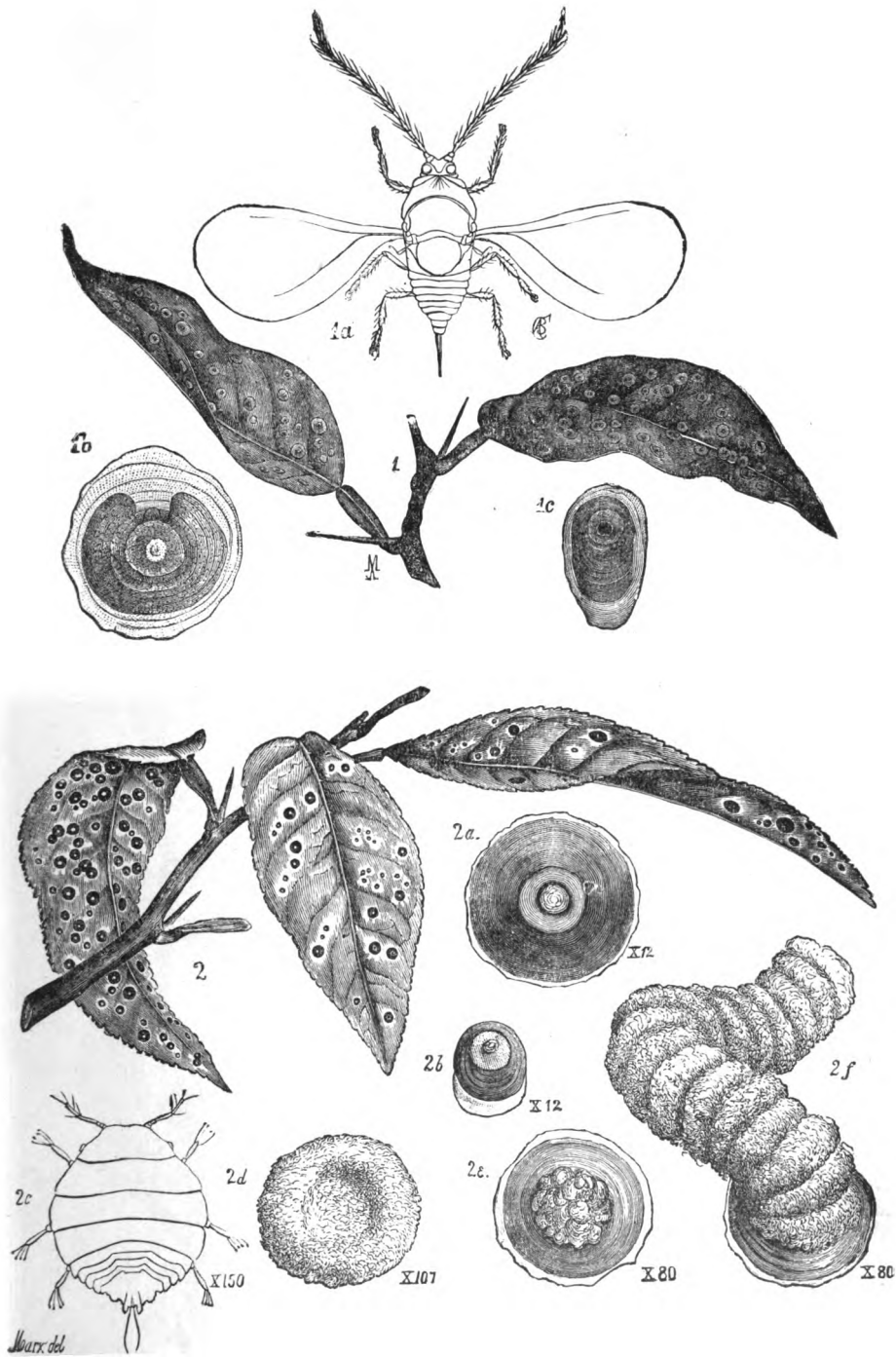
FIG. 1.—*Mytilaspis pandanni* n. sp.
FIG. 2.—*Mytilaspis pandanni* n. sp.
FIG. 3.—*Mytilaspis citricola* (Pack.).
FIG. 4.—*Fiorinia camelliae* n. sp. Dorsal view.
FIG. 5.—*Parlatoria pergandii* n. sp.

PLATE XXI

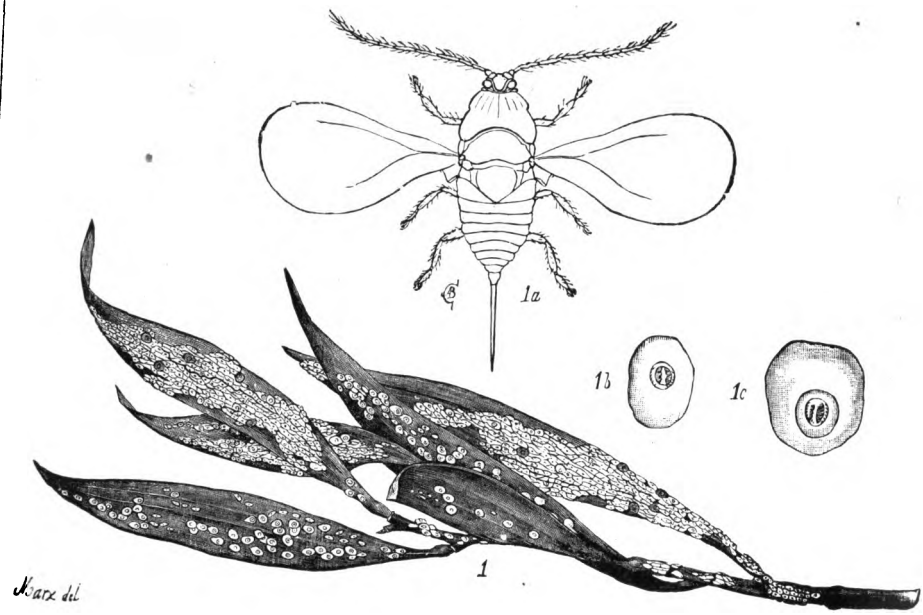
FIG. 1.—*Mytilaspis Gloverii* (Pack.).
FIG. 2.—*Aspidiotus ancylus* Putnam.
FIG. 3.—*Aspidiotus ficus* (Riley MSS.)
FIG. 4.—*Aspidiotus ancylus* Putnam.
FIG. 5.—*Diaspis rosae* (Sand.).
FIG. 6.—*Diaspis carueli* Targ.-Tozz.
FIG. 7.—*Aspidiotus* (?) *pini* n. sp.
FIG. 8.—*Parlatoria pergandii* n. sp.

PLATE XXII

FIG. 1.—*Dactylopius longifilis* n. sp. Male, enlarged.
FIG. 2.—*Dactylopius destructor* n. sp. Male, enlarged.



(Plate XI, Cornell series)



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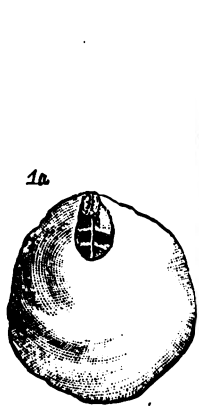
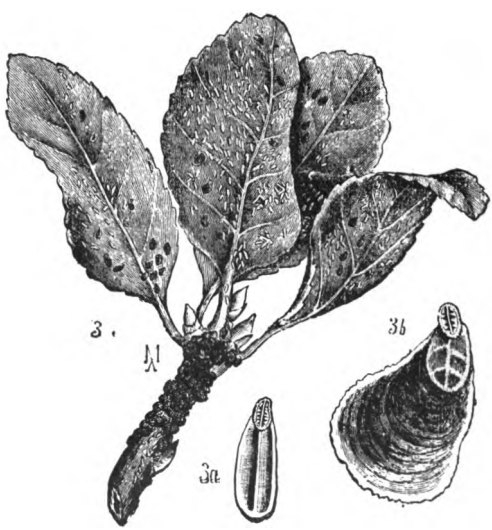
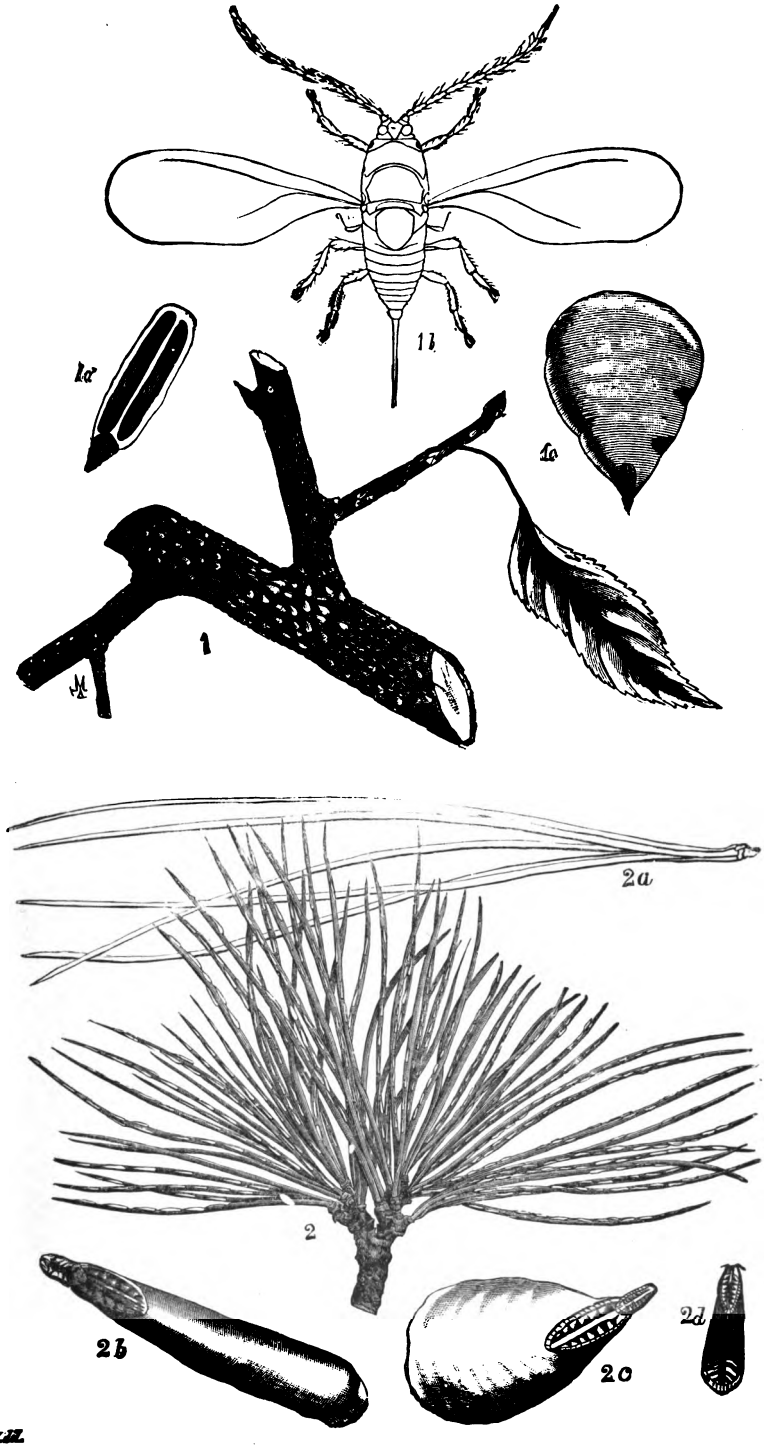


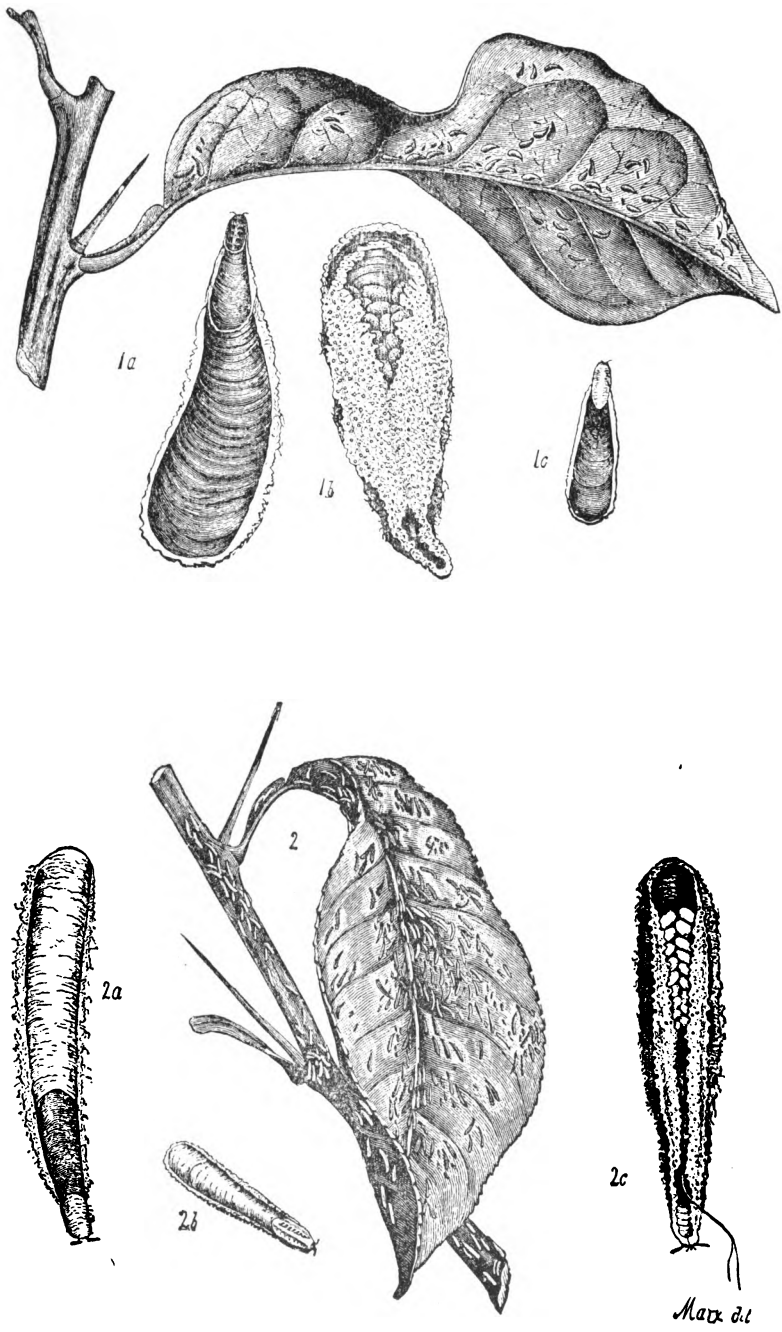


Marx del

(Plate XIII, Cornell series)



(Plate XIV, Cornell series)



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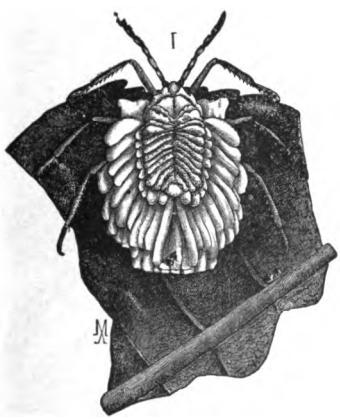

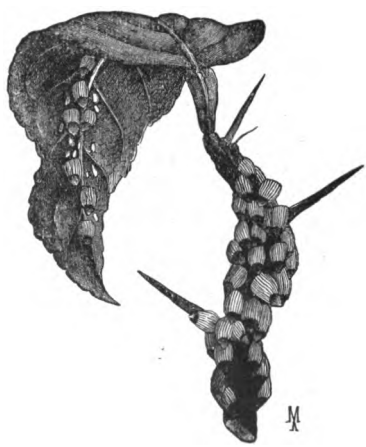

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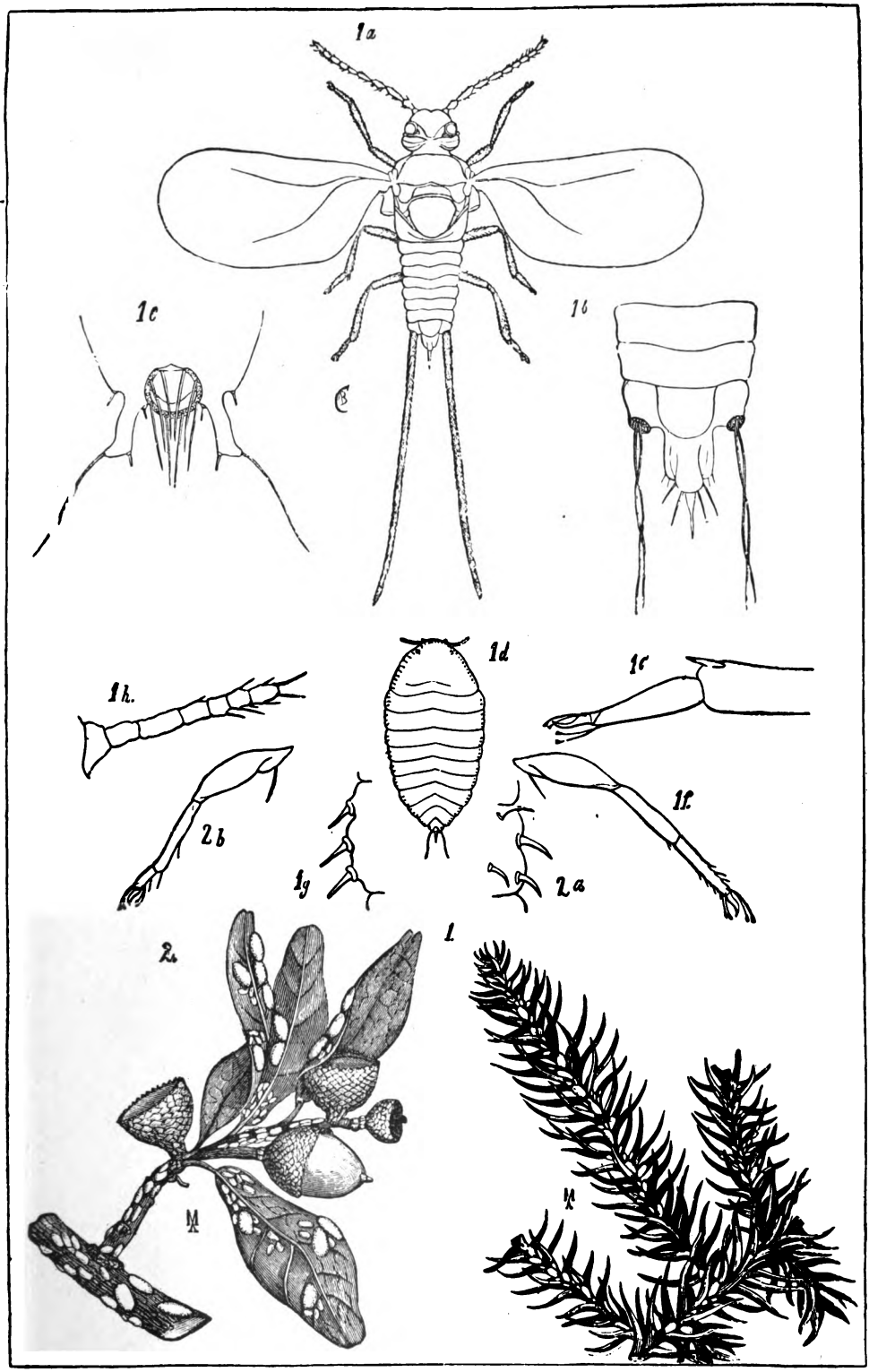

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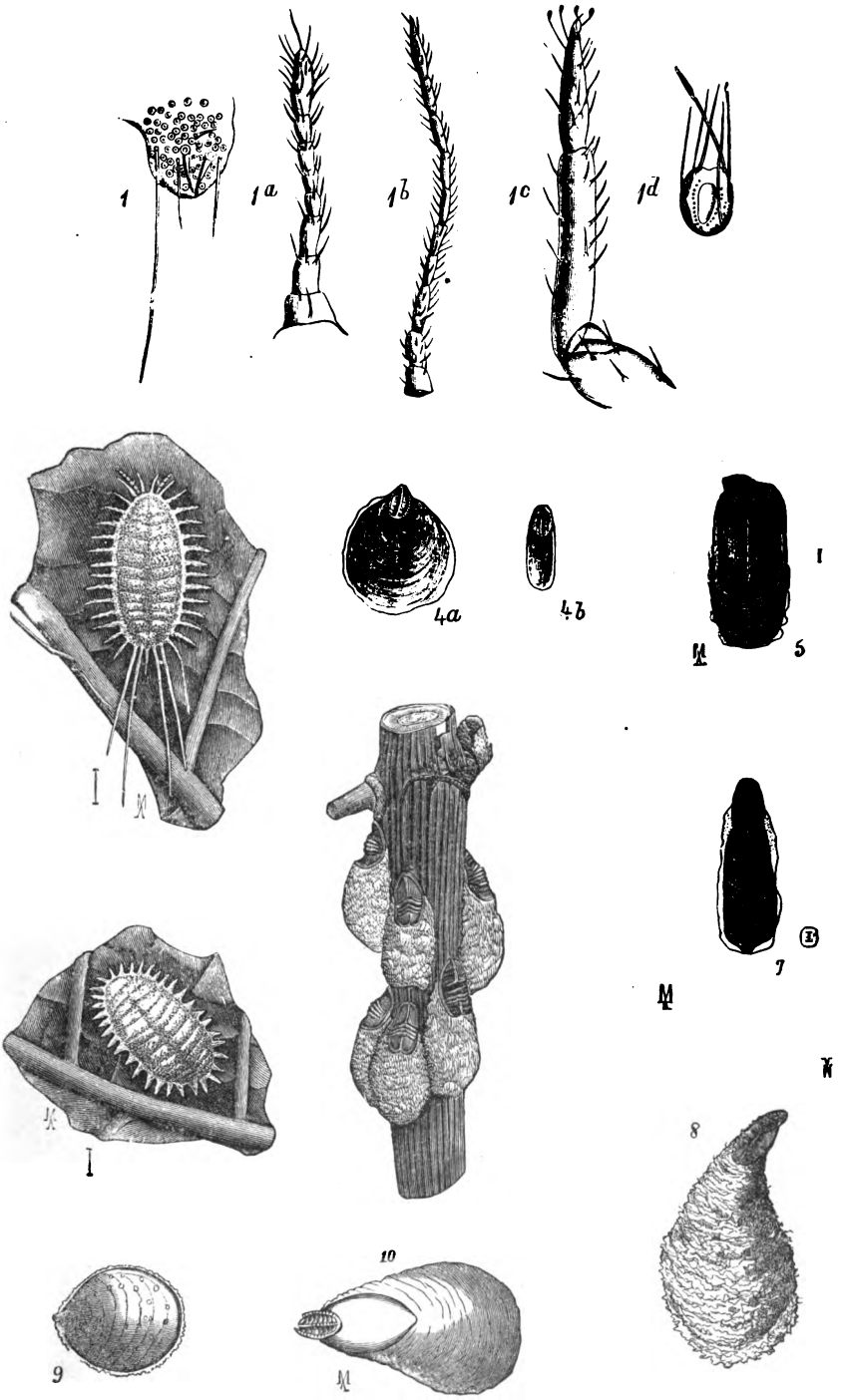

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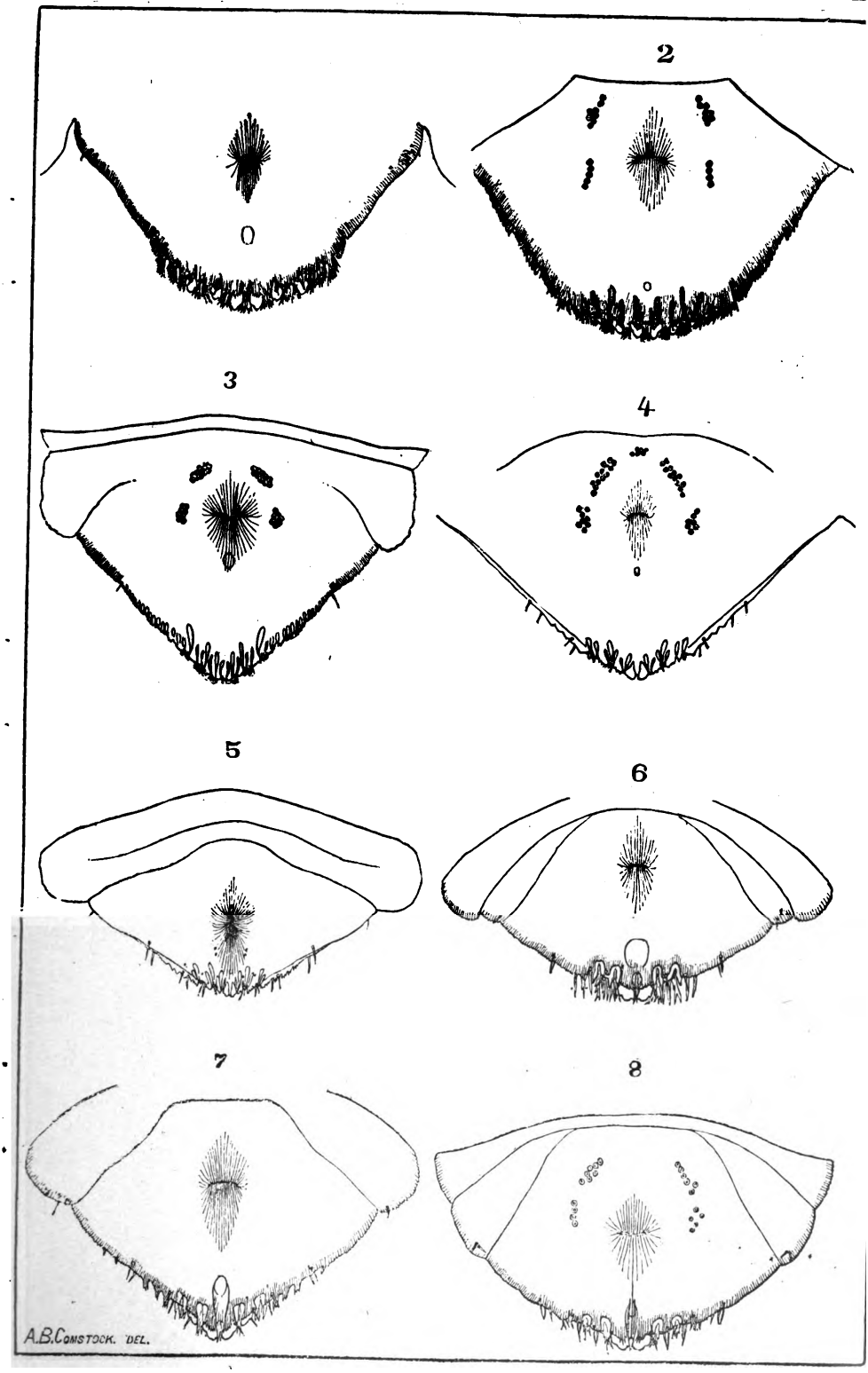

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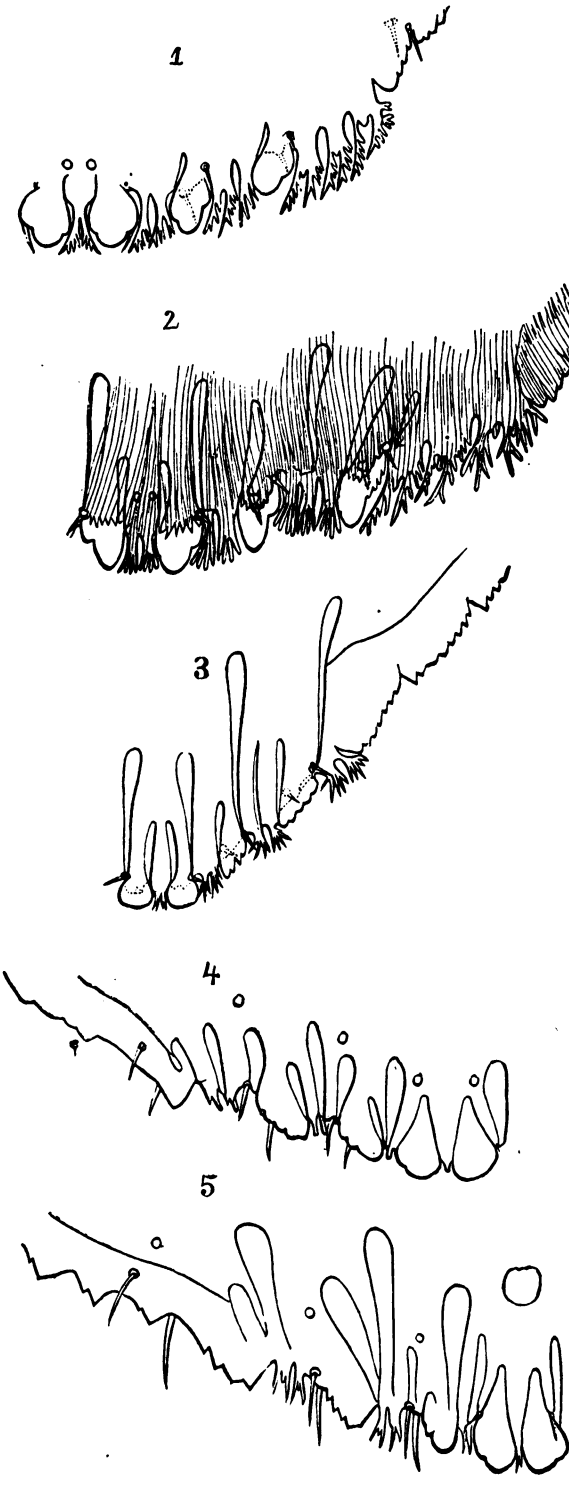

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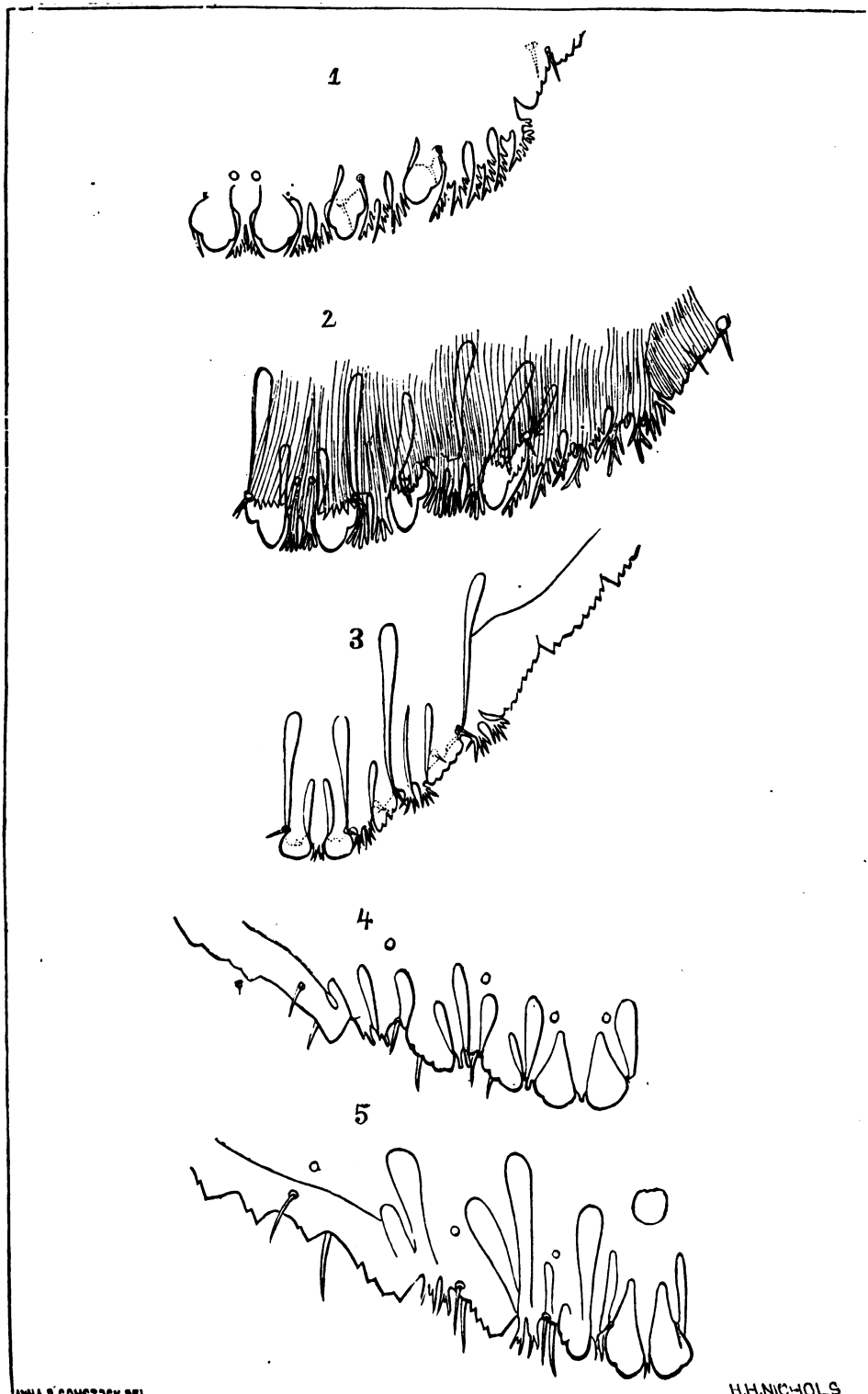

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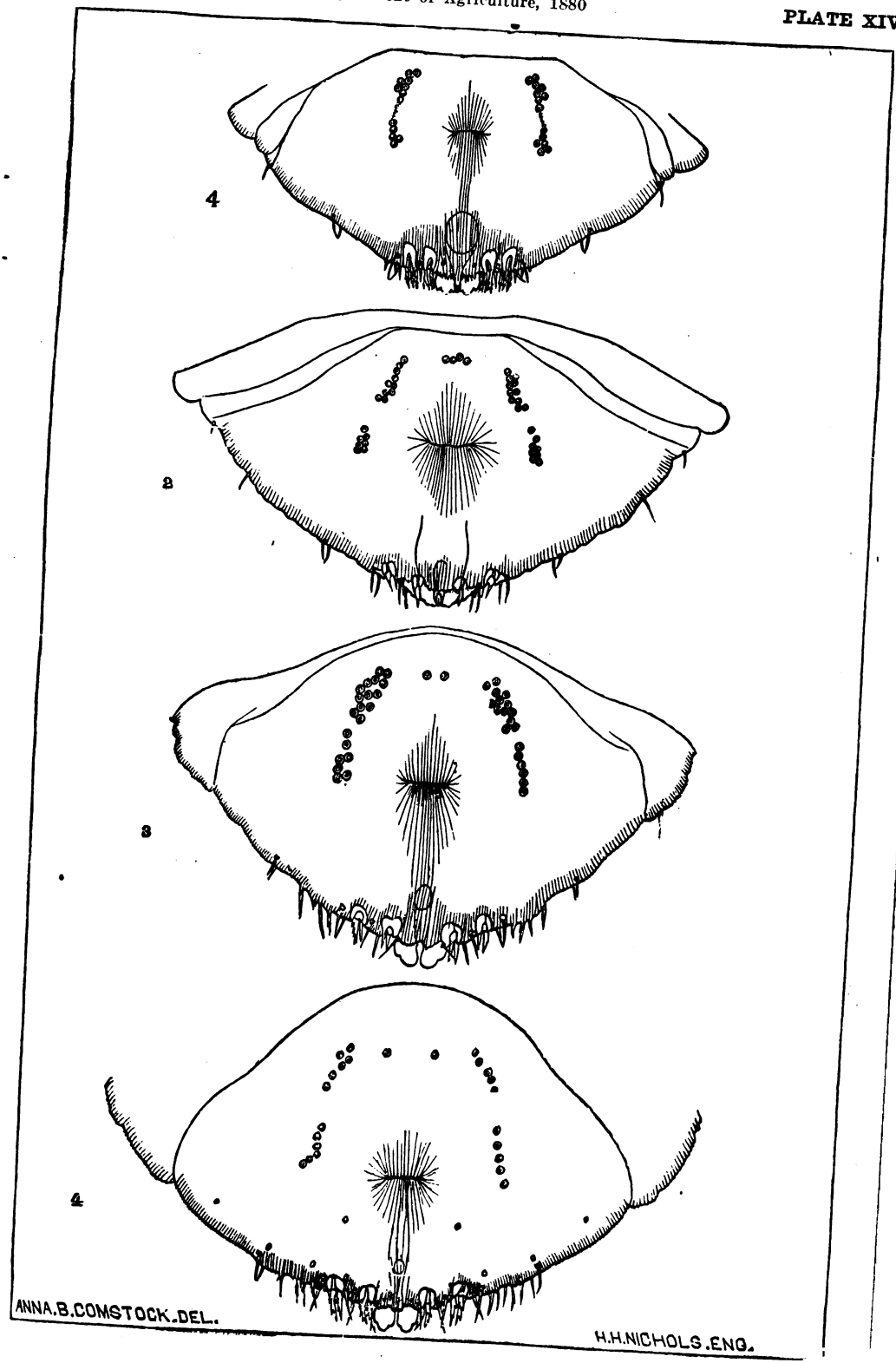
PLATE XIV



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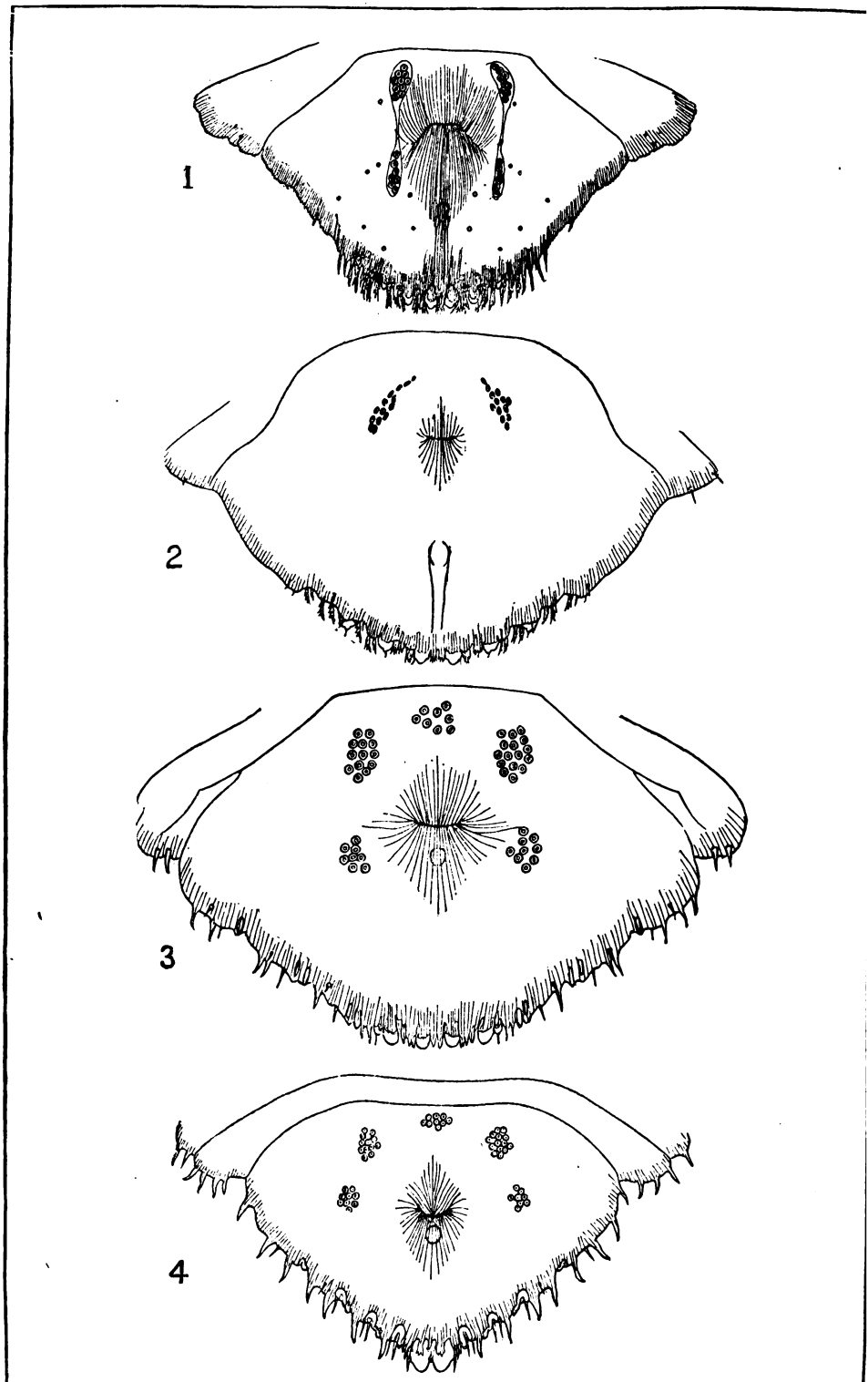

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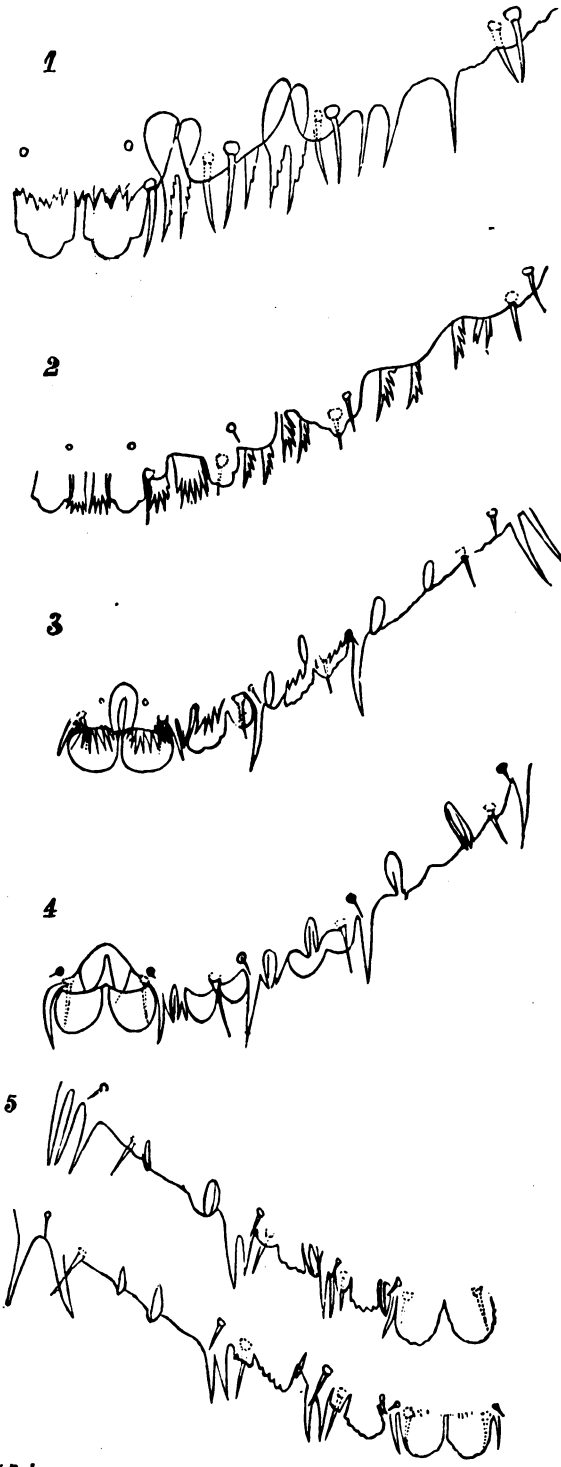
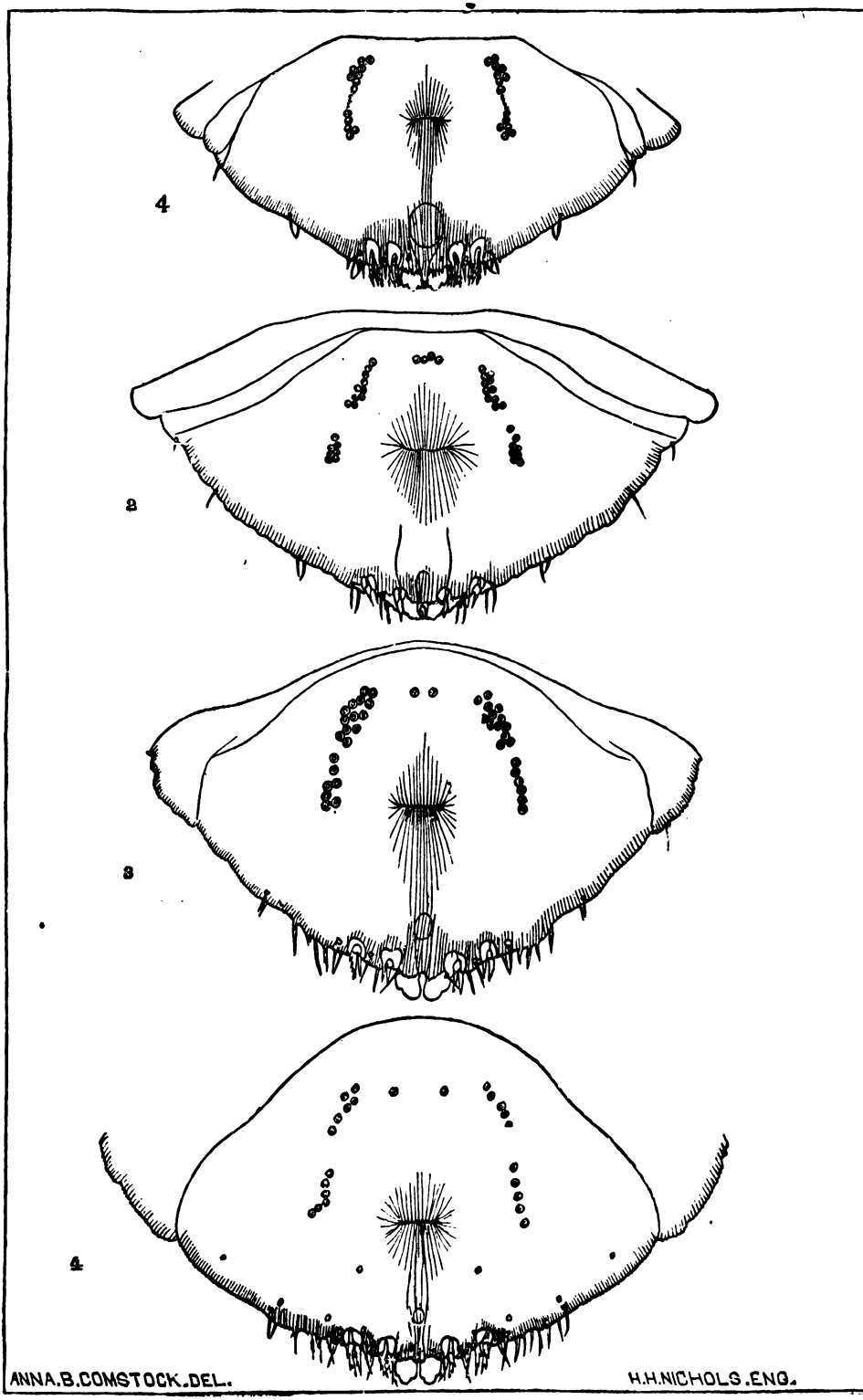


ANNA B. COMSTOCK, Del. H H NICHOLS, Sc.

(Plate XXIV, Cornell series)

(Plate XXI, Cornell series)



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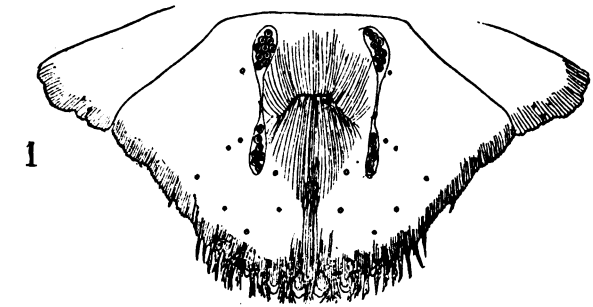

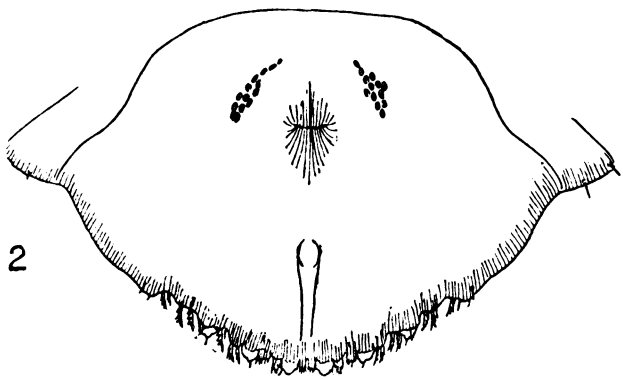

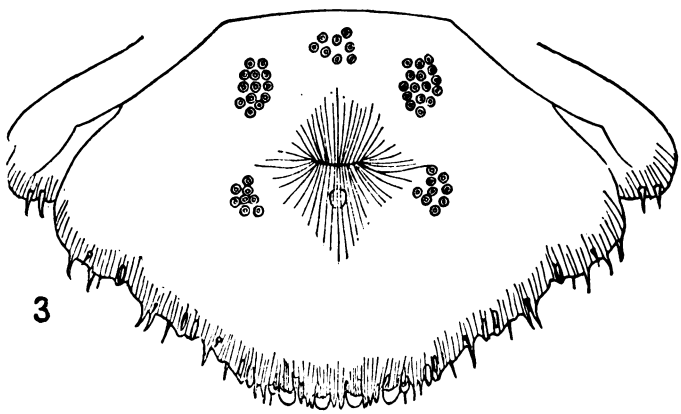

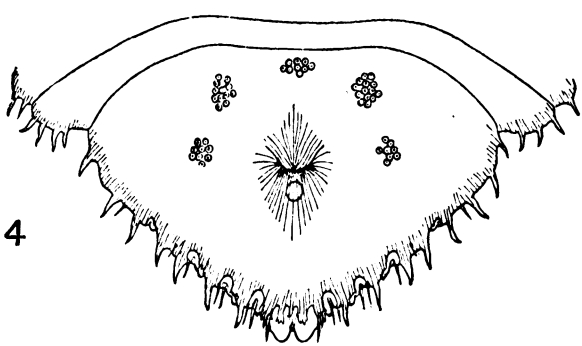

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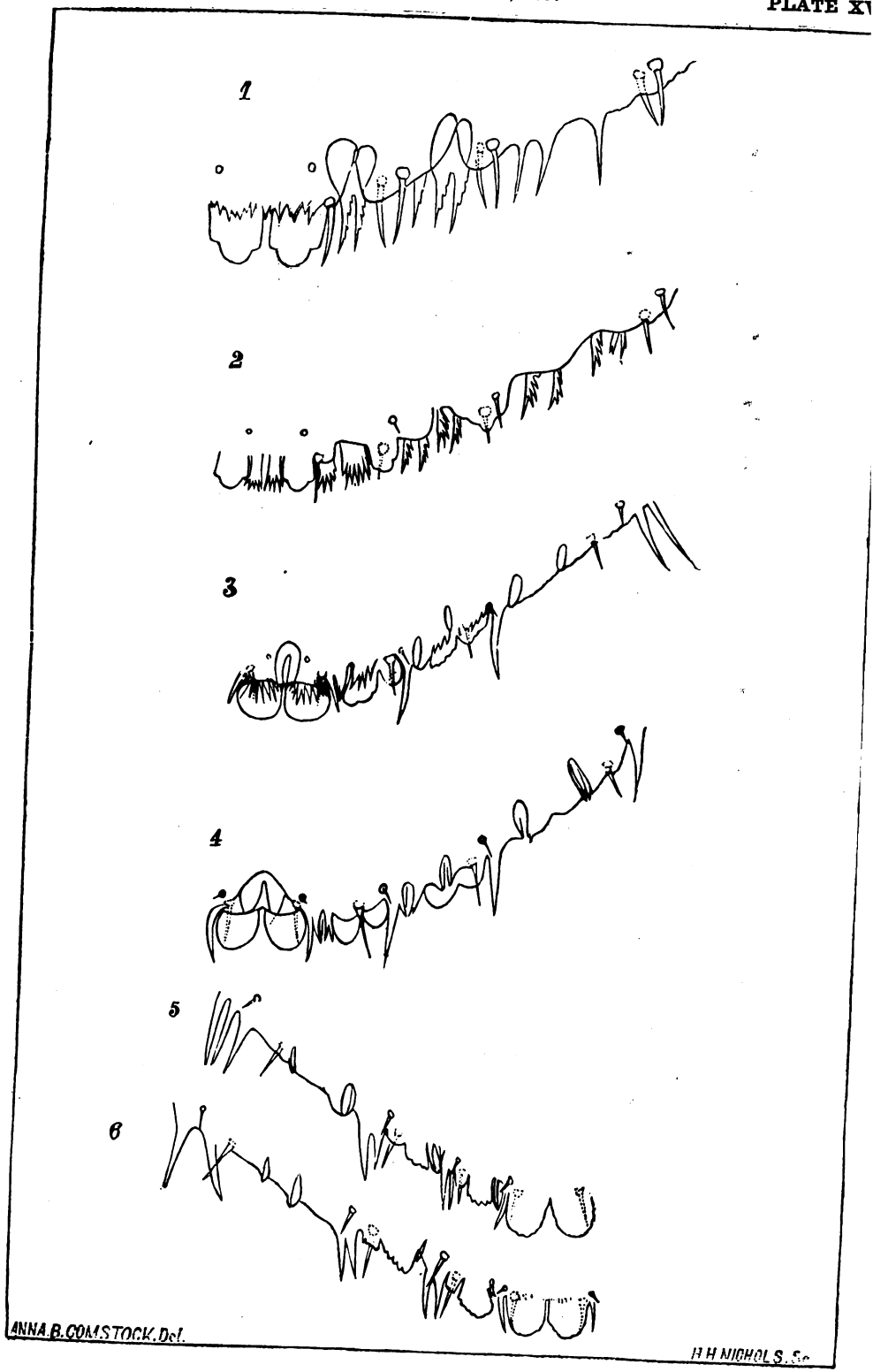

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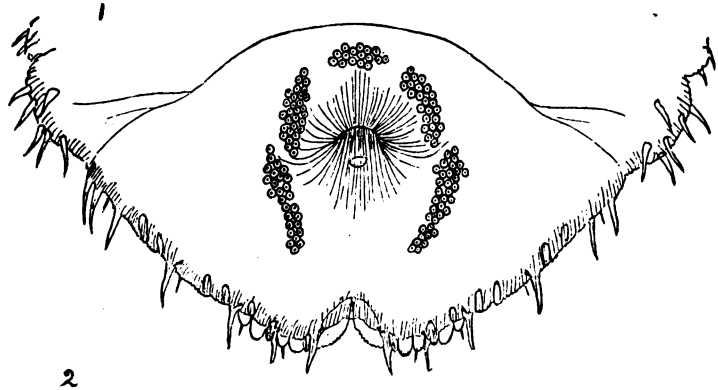

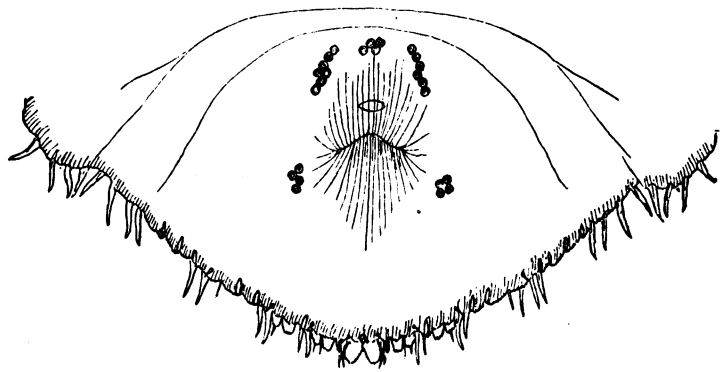

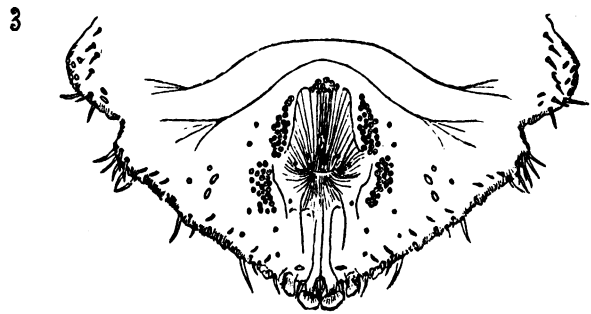

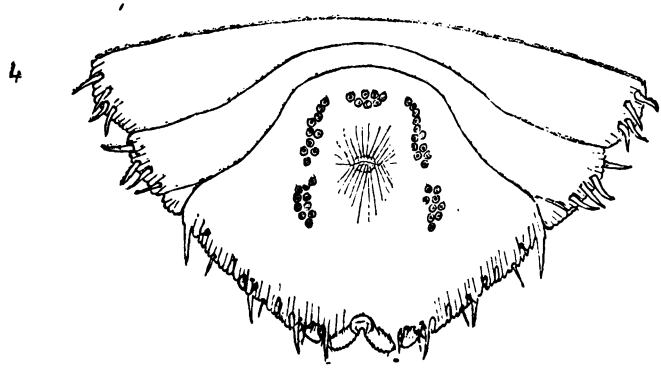

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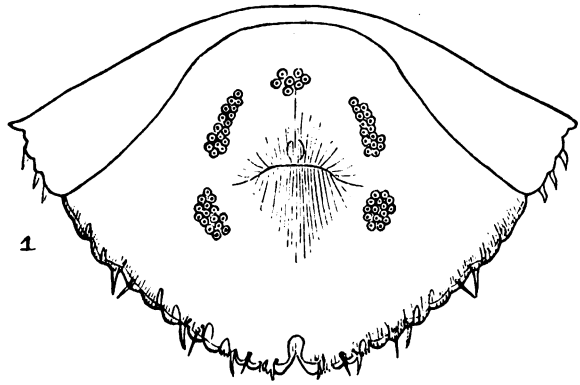
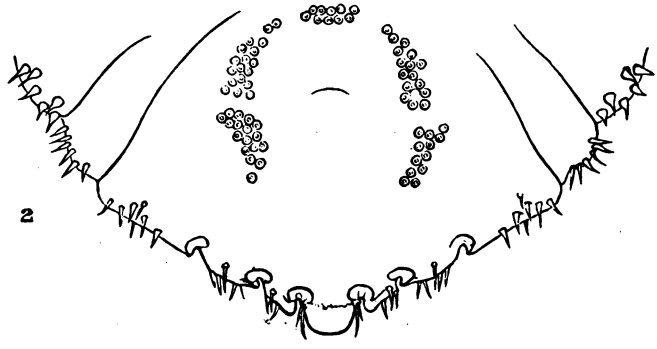
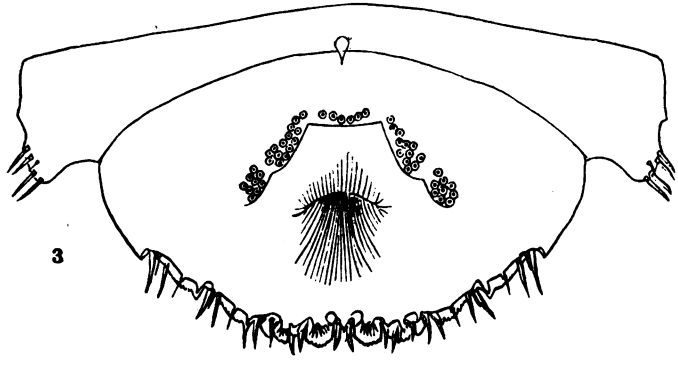
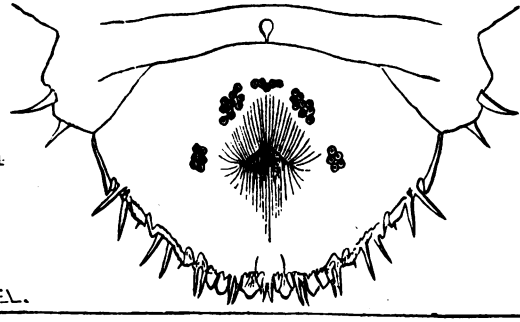


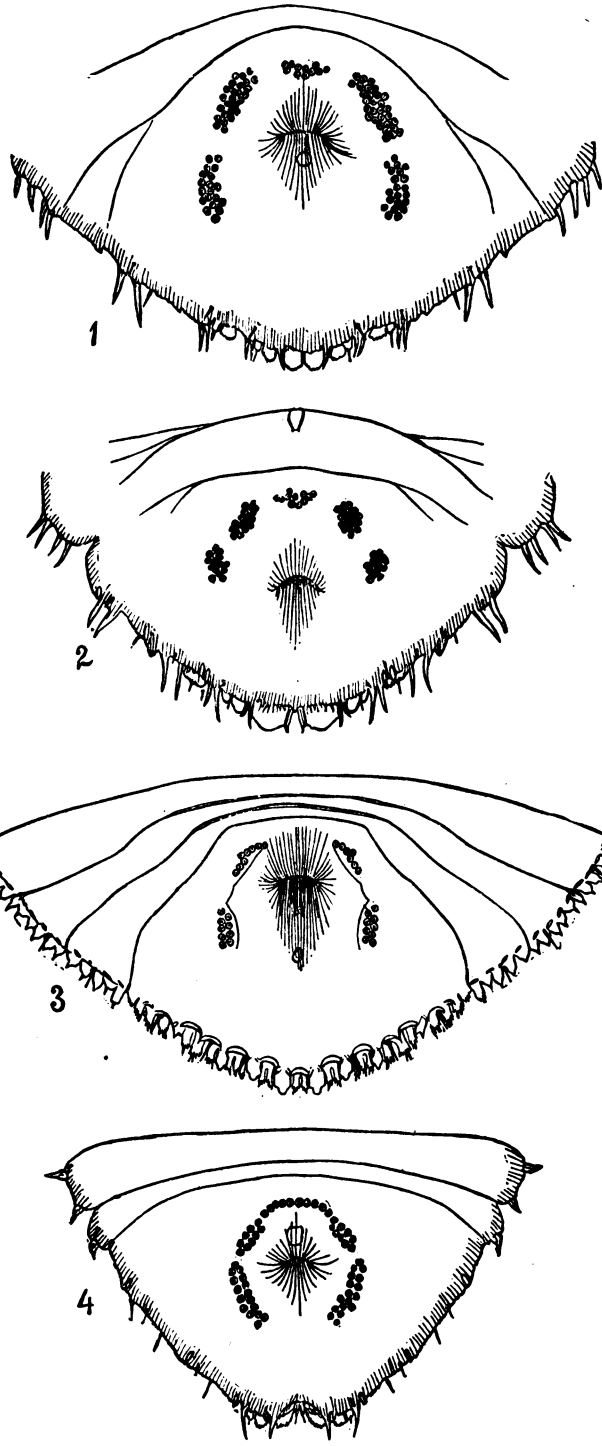






ANNA.B.COMSTOCK.DEL. H.H.NICHOLS

(Plate XXVI, Cornell series)



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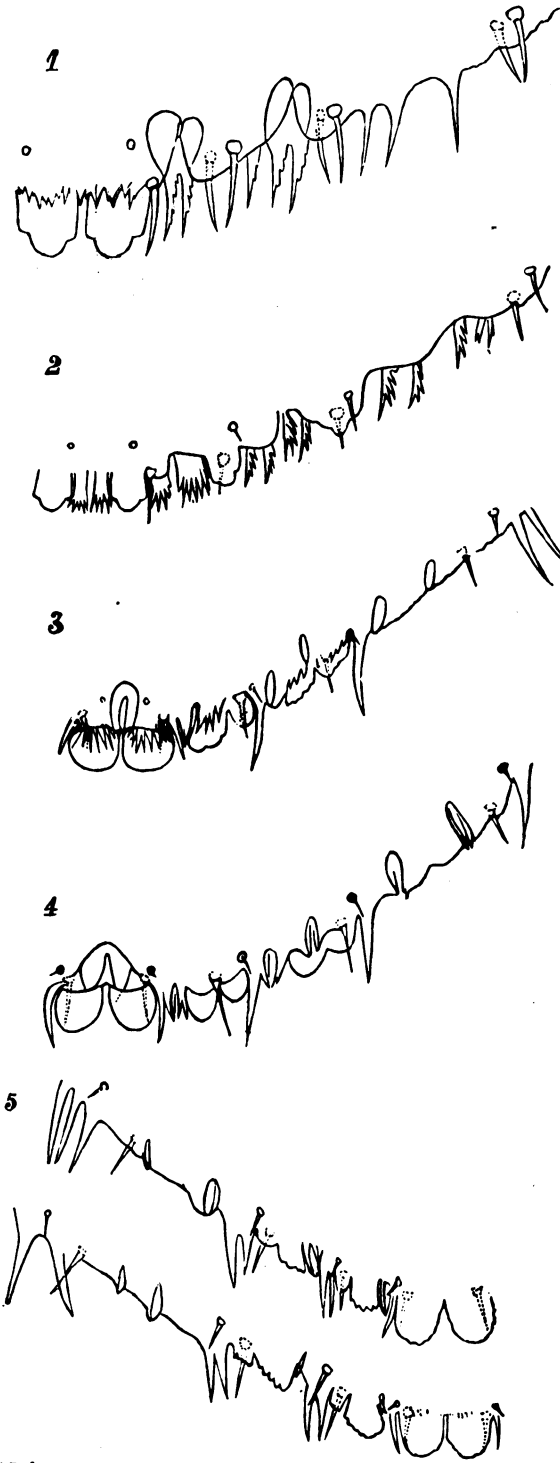
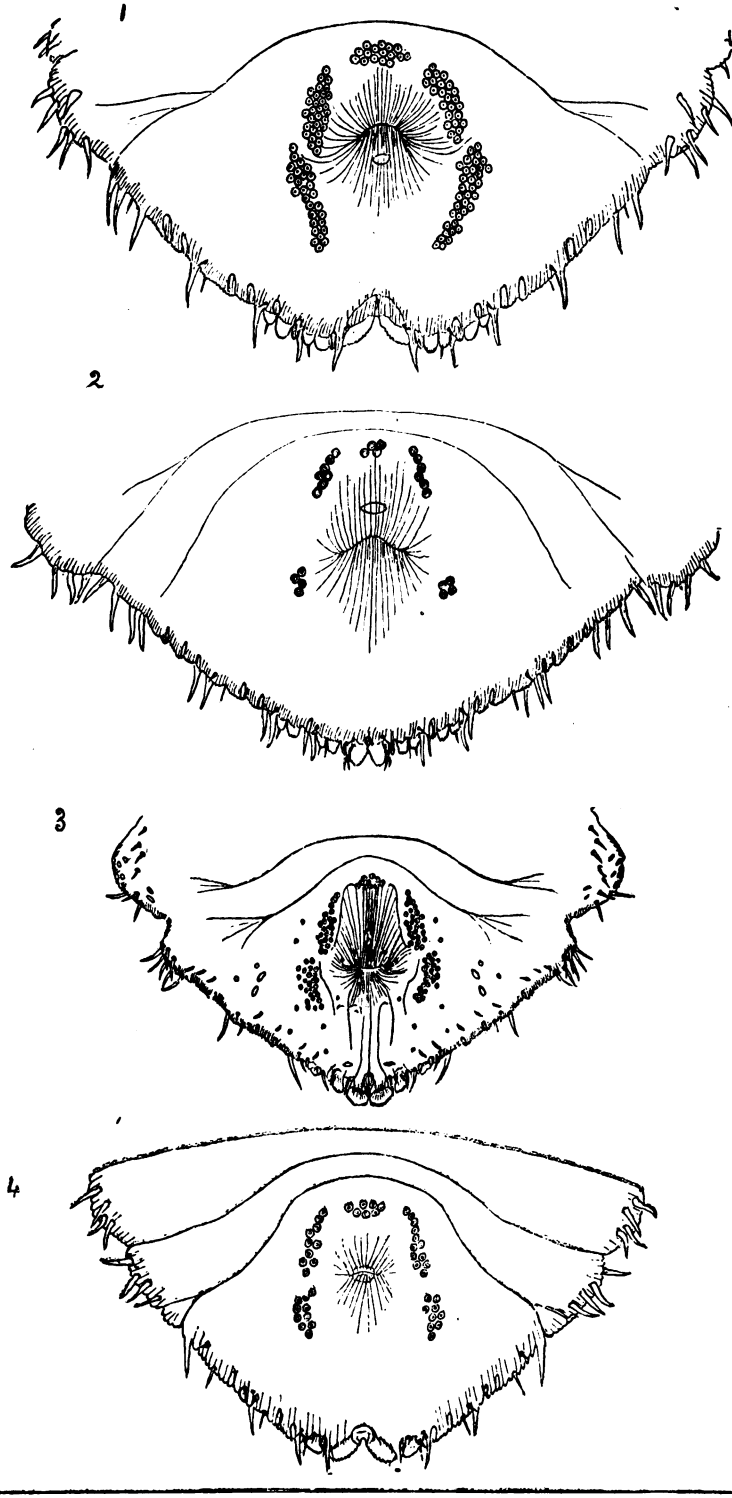


ANNA B. COMSTOCK, Del. H. H. NICHOLS, Sc.

(Plate XXIV, Cornell series)



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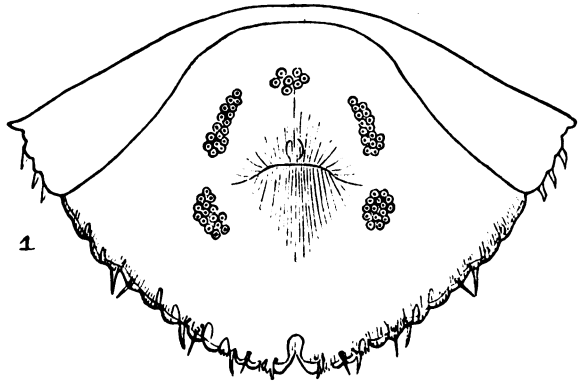

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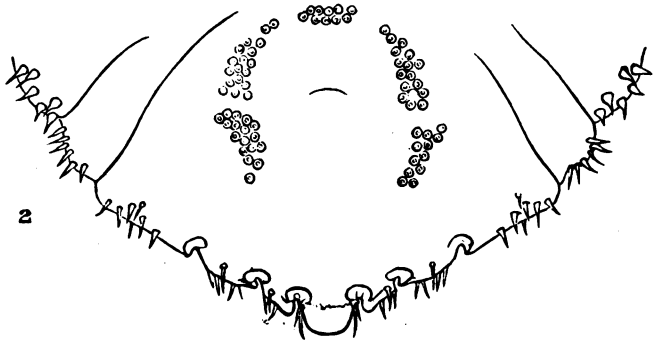

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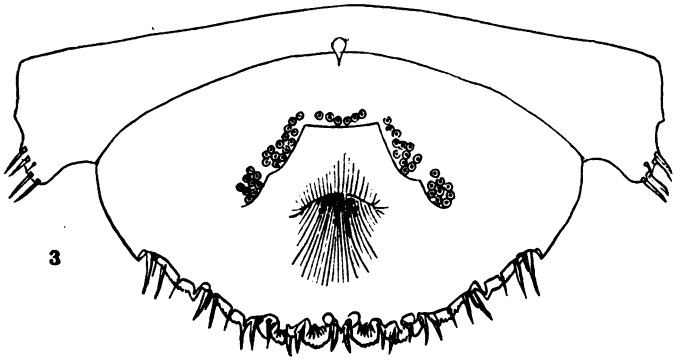

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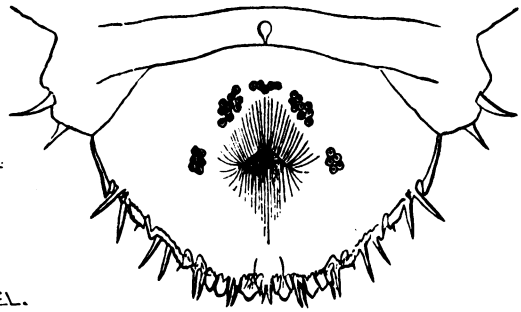

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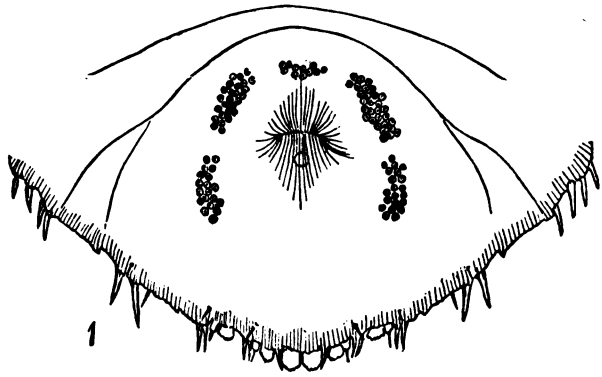
ANNA.B.COMSTOCK.DEL. H.H.NICHOLS

(Plate XXVI, Cornell series)



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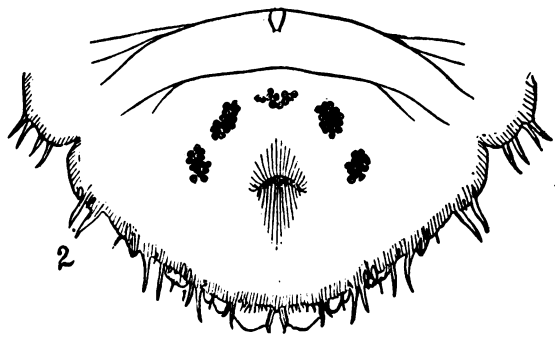

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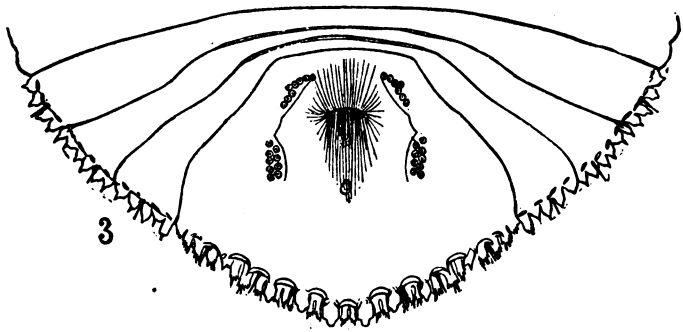

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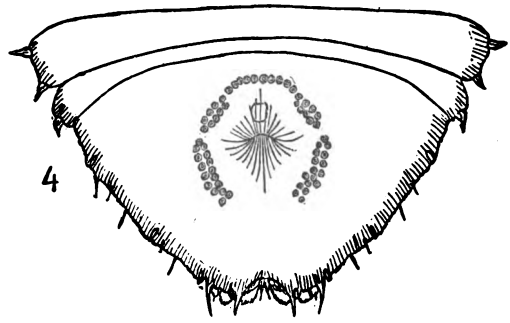

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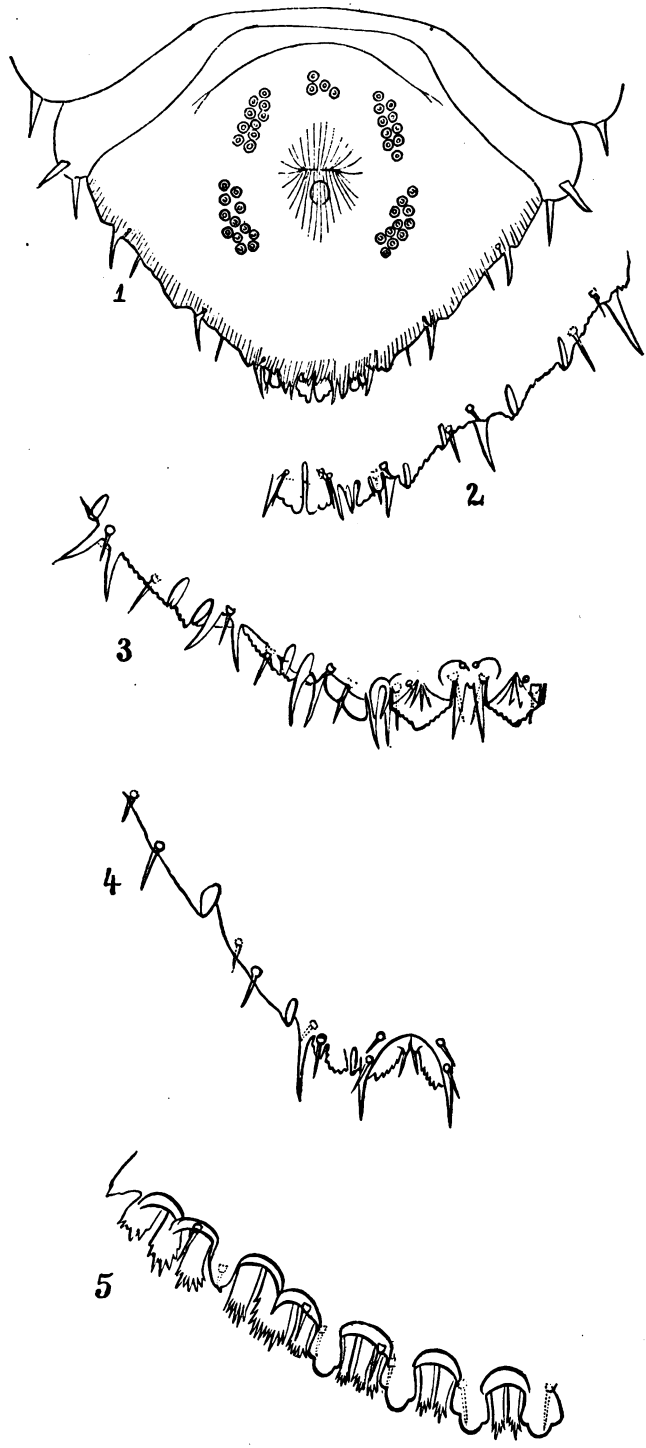
A.B.C. Del.

(Plate XXVII, Cornell series)



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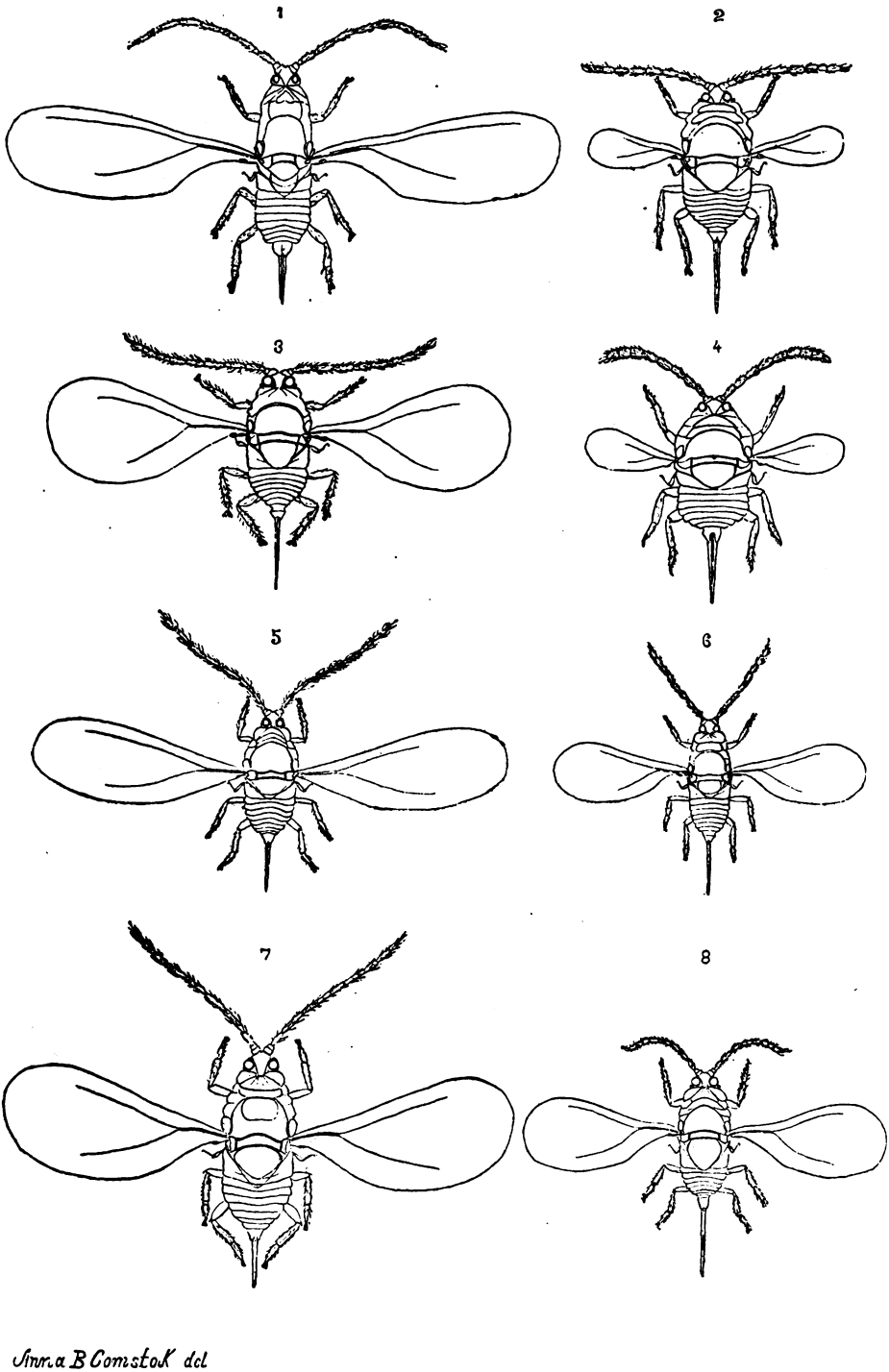

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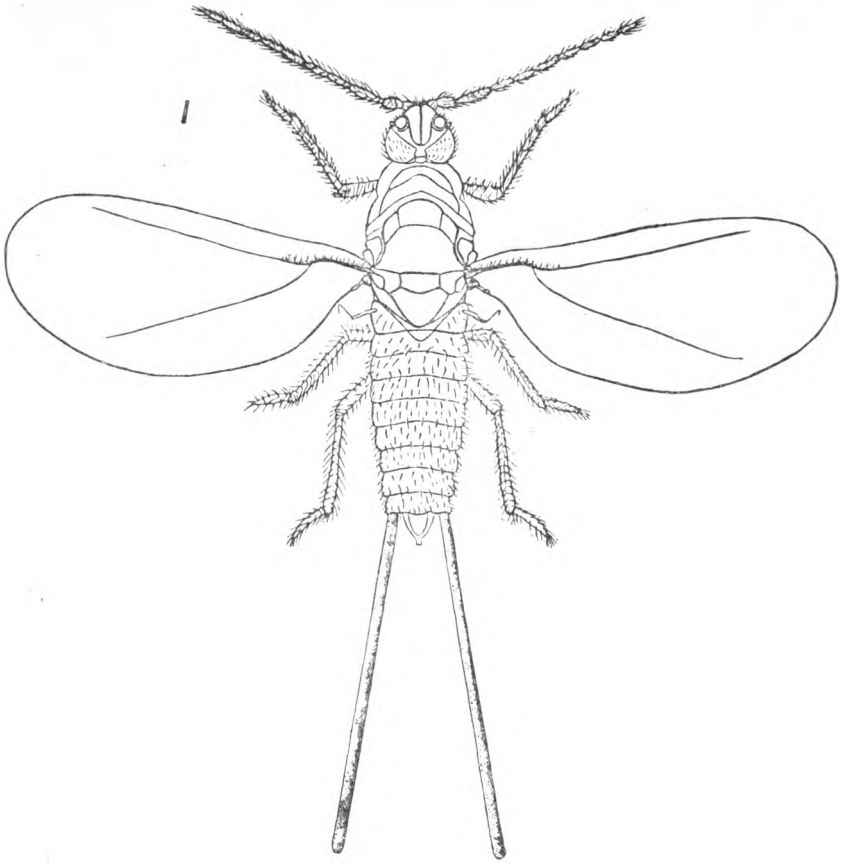
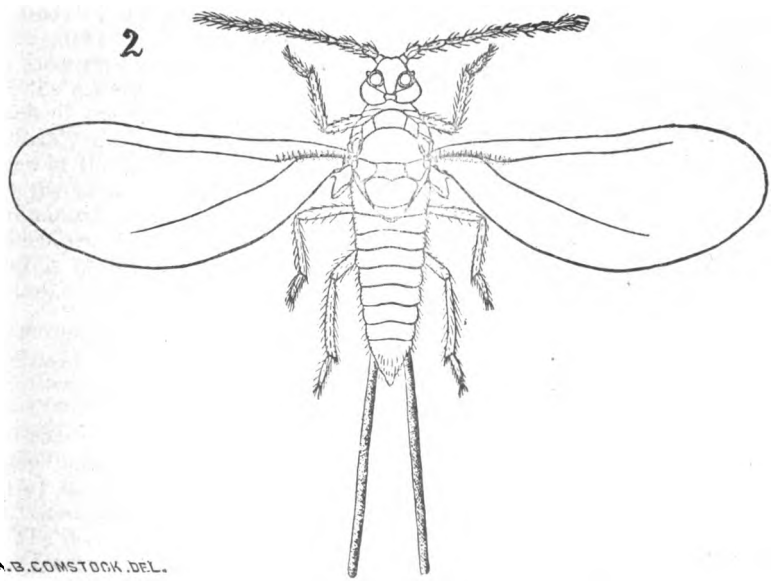




ANNA.B.COMSTOCK.DEL. H.H.NICHOLS.ENG.

(Plate XXX, Cornell series)

REPORT OF THE ENTOMOLOGIST, UNITED STATES DEPARTMENT OF AGRICULTURE

(The following six pages and two plates are from the Report of the Commissioner of Agriculture for the years 1881 and 1882)

LAC INSECTS

It is now more than one hundred years since *Carteria lacca,* the insect which produces the lac of commerce, was first described.* Since that time many articles have been written respecting it. Owing to the importance in the industrial arts of shellac and the lac dyes, the origin of these substances is discussed in nearly all of the larger cyclopedias; and the list of the memoirs on this subject in the scientific journals is a long one. Notwithstanding this, an examination which I have made of the matter convinces me that the subject is not yet well understood.

I was led to study this insect by the fact that I have met with two other species of lac insects which are as yet undescribed. The result of this study shows that although the two new lac insects are American they are congeneric with the Asiatic species.

The opportunity of comparing three species of this important genus has enabled me to make some interesting observations, but owing to lack of time I can now give only a general statement of the results of my studies. I am led to make this statement now, as the knowledge of the fact that true lac insects occur in this country may prove of economic importance.

The genus Carteria was established by Signoret† for the lac insect of commerce. The two undescribed lac insects agree with this one in the following characters:

Genus **CARTERIA** Signoret

Body of the adult female sac-like in form, with no legs, and imbedded in a mass of the substance known as lac. The caudal end of the body is furnished with three prominent tubercles; one, the largest, consists of the caudal segment of the body and is terminated by the anal ring; each of the others bears at its distal extremity a perforated plate, presumably the organ through which the lac is excreted; near the base of each of the lac tubes is a large spiracle. In the triangular space inclosed by the three tubercles described is a fourth tubercle which bears a very prominent spine-like organ. The anal ring consists of several plates, which are perforated by many openings; the anal ring bears ten hairs, and is at least partially surrounded by a series of toothed plates and spines.

CARTERIA LACCA (Kerr) (Plate XIX, figs. 2–2*g*)

Coccus lacca Kerr. Phil. Trans., 1781, 374.
Coccus ficus Fabr. Mantissa, 1787, II, 319.
Carteria lacca (Kerr) Signoret. Essai, 1874, 101.

From a quantity of commercial stick-lac purchased in New York I obtained specimens of an insect which I have no doubt is the *Coccus* (*Carteria*) *lacca* of authors. From these specimens the following description and accompanying figures were drawn.

The best specimens of this lac are in the form of an incrustation from one-fourth inch to three-eighths inch in thickness upon small twigs

* James Kerr, Philosophical Transactions, 1781, 384.
† Essai, 1874, p. 101.

(Plate XIX, fig. 2). This incrustation is filled with elongated cells. The longer axis of each cell is at right angles to the twig, and in each case the end of the cell next the twig is small, while the outer end is considerably enlarged. In well-preserved specimens three tubular openings may be seen extending from the outer end of each cell through the incrustation to the open air, and in each cell may be found the shriveled remains of an insect, which, when alive, evidently nearly filled the cell and determined its form.

By soaking the insects in water they may be made to swell out, and thus the natural form of the body be ascertained. This is represented at figure 2*a*. The cephalic end is small, and, in addition to mouth parts of the form characteristic of the Coccidae, is furnished with a pair of fleshy appendages (Fig. 2*d*). The body enlarges gradually toward the caudal end. This end is of the peculiar form described above in the characterization of the genus. In a word, the shape of the body is that of a jug with three necks and a pointed bottom, the cephalic end forming the bottom. Each of the neck-like prolongations of this jug-shaped body fits into one of the three tubular openings of the cell. One of these openings is larger than the others; this is the one occupied by the anal tubercle.

The anal tubercle consists of the whole of the last segment of the body, and a part of the penultimate segment (Fig. 2*e*). The anal ring bears ten hairs and consists of several plates (Fig. 2*f*). The hairs of the anal ring are spine-like. Each is curved outward near the middle of its length, and each one is hollow and situated over a large opening in the plate which bears it. There are also many smaller openings distributed evenly over the surface of the plates.

There is a fringe of notched plates and spines on that side of the segment which is toward the lac tubes (Figs. 2*e* and 2*g*). I have been unable to trace any tracheæ extending to the numerous openings with which the lac tubes are furnished; but the distal extremity of each tubercle contains many tubular glands, which in some instances I have traced to these openings. The structure of these organs is represented at figure 2*b*.

There are four spiracles, a large one at the base of each of the lac tubercles, and a pair of smaller ones near the head end of the body. Evidently the air must have free access to the cell, else these spiracles would be of little use. The air probably enters through the opening made by the caudal segment. In all the specimens which I have examined, in which the insect was unbroken, the lac tubes were within the corresponding tubular openings of the cell, but in no instance have I found the anal tubercle in the third opening. In each case it had been withdrawn into the cell, and occupied a position just below the anal opening (Fig. 2*a*). This withdrawal may be due to the shrinking of the body after death; but the fact that it is always the anal tubercle that is withdrawn, and not either of the others, indicates that during life this tubercle cannot be permanently fixed in its opening. The withdrawal of the anal tubercle at intervals would admit the air to the cell, and thus provide for respiration. The peculiar bending of the hairs of the anal ring is such as would facilitate the pushing of the anal tubercle into the opening after it had been withdrawn.

I have been unable to ascertain the function of the large spine. As these insects are viviparous the spine cannot be an ovipositor. The only author who I find makes mention of it is Gernet,* who simply

* Einiges ueber *Coccus lacca* und dessen Parasiten, *Moskau*, 1863.

states that there exists midway between the three tubercles a small, thickened spine, which appears to be nothing else than an enlarged bristle of the last, or next to the last, segment of the abdomen. He also states that sometimes there are two of these spines, and figures a female with two. This is undoubtedly an error.

The fullest account which has been published respecting this insect is that of H. J. Carter,* in whose honor the genus was named. Mr. Carter's memoir is a very important one, but he has fell into some errors. From his account it is evident that the insect, like many others of the Coccidae, excretes considerable masses of apparently woolly matter. This matter is probably excreted by spinnerets upon each of the three caudal tubercles, and projects from each of the three openings in the cell. The remains of these threads of excretion may sometimes be seen in the stick-lac as it reaches us, but the greater part of them are brushed or blown away. Carter believed these threads to be external tracheæ, and he figured internal tracheæ communicating with them. He even represents "tufts of tracheæ" projecting from the anus. He appears to have overlooked entirely the true spiracles, and believed the paired tubercles to be simply for respiration. No mention is made of the spine, and in the description of the male the caudal threads of excretion are spoken of as tracheæ.

CARTERIA LARREÆ, new species (Plate XX, figs. 1–1*h*)

The creosote plant (*Larrea mexicana*) is a shrub growing, from 4 to 6 feet high, very abundantly in certain regions in the southwestern portion of the United States and in Mexico. It is said to form

> a dense and almost impassable scrub, particularly on the borders of the Colorado desert, where its luxuriant growth puts a stop to the drifting sand. It is a sure sign of a sterile soil, for wherever it flourishes little else can be found, and although it gives the scenery a beautiful, verdant appearance, its strong, creosote-like odor renders it so repulsive that no animal will touch it. Moreover, as it can scarcely be made to burn, it is useless even for the purpose of fuel. The resinous matter to which the odor is due abounds in all parts of the plant. The Pimos Indians collect and form it into balls, which they kick before them as they journey from one point to the other of their trail.†

This extract gives, in a few words, what was until recently the accepted belief respecting American lac. But in April, 1880, Mr. J. M. Stillman presented to the California Academy of Sciences ‡ a very able and important paper on this subject, in which he showed that the so-called resinous exudation of the creosote plant was apparently identical with the gum-lac from India. Mr. Stillman also gave very cogent chemical and physical reasons for believing that in each case the lac is excreted by the insects found in it instead of being simply an exudation of the plant caused by the punctures of these insects, as is stated in nearly all of the writings on the subject. The presence of the large and complicated excreting organs, which I have termed lac tubes in each of the species described in this paper, confirms this conclusion.

A study of the insect which produces the American lac shows that it is specifically distinct from *Carteria lacca*. I therefore propose the name *C. larreæ* for it. In all the specimens which I have seen, the incrustation of lac is not as thick as that produced by *C. lacca*, being rarely more than one-eighth of an inch in thickness. And the masses excreted

* Annals and Magazine of Natural History, 1861, p. 1–10.

† A. Smith, in the Treasury of Botany.

‡ See American Naturalist, Vol. XIV, p. 782.

by the different individuals are not crowded together so compactly as in the Indian species, but preserve a more or less globular form. (See Plate XX, fig. 1.) In the case of isolated masses there is a tendency to a six-lobed condition.

This species is the smallest of the three known lac insects, the adult female being but little more than 2 mm. (.08 inch) in diameter. The body is nearly globular in outline, with, however, prominent lac tubes and anal tubercle. The caudal spiracles are also prominent. Figure 1*a* represents an individual from which the greater part of the lac has been dissolved. A specimen treated in this way served to show the general form of the body. The structure of the different organs was studied upon specimens which had been boiled in caustic potash, and from which in this way all the excretion had been removed. Figure 1*d* represents the anal tubercle with the anal ring and fringe. Figure 1*f* shows a part of the fringe enlarged. One of the lac tubes with its perforated plate is represented at figure 1*g*, the corresponding spiracle at figure 1*h*, and the spine at figure 1*e*. Scattered over the surface of the body are groups of organs which appear like the compound spinnerets of the Diaspinae. One of these groups is represented at figure 1*c*. The male of this species was found, but in too mutilated condition for detailed description. A shriveled balsam-mounted specimen showed the body, including the style, to be 1 mm. ($\frac{1}{25}$ inch) in length. The length of the style is two-sevenths of the whole length of the body. On each side of the style there is a pair of hairs which resemble those of *Rhizococcus araucariae*. (See Agricultural Report, 1880, Plate X, fig. 1*b*.) The antennæ and wings are normal. The sac of the male is egg-shaped. Only empty ones were observed, each of which had an opening at one end from which the male doubtless emerged (Fig. 1*d*). The sac is about 1.5 mm. (.06 inch) in length. They occur in masses.

CARTERIA MEXICANA, new species (Plate XIX, figs. 1–1*h*)

On looking over the collection of coccids in the Museum of Comparative Zoology, which Dr. Hagen kindly placed at my disposal, I found a twig of mimosa from Tampico, Mex., which bore a number of globular or more or less stellate masses of what proved on further examination to be lac. Each of these masses contained an insect. This insect proves to belong to the same genus as the two lac insects already described, but is specifically distinct from either.

As the specimen which I have is a very small twig, which bore only about fifteen insects, it may not represent well the usual appearance of this lac. On this twig the lumps of lac excreted by the individual insects occur singly or are but slightly massed. Each lump is six-lobed at its base; this is more marked in the case of the immature specimens than with the adults (Plate XIX, fig. 1). This stellate form of the lump of lac is due to a similar form of the body of the insect which excretes it. Figure 1*a* represents an immature female seen from above, which is approximately from the caudal end. The natural attitude of the insect is, like that of the other lac insects, with its cephalic end next to the plant and the caudal end farthest from it. The specimen from which the figure was drawn had been boiled in caustic potash, and thus rendered transparent. The mouth parts and antennæ are represented as showing through the body; the other organs figured are on the caudo-dorsal surface of the body. The anal tubercle and the spine are well developed. The perforated plates, the openings of the lac glands, are also well developed, but are sessile. This is the most obvious difference between this stage and the adult. Closely associated with each perfo-

rated plate is a large spiracle; these being on the sides of the body are shown only in profile.

The form of the body of an adult female is represented at figure 1*d*. In this stage the lac tubes are well developed, as shown in the figure. The extremity of a single lac tube, with its perforated plate, is represented at figure 1*e*. Four spiracles are present, one on each side of the body laterad of the anal tubercle, and a pair near the mouth parts (Fig. 1*d*). One of the caudal spiracles is represented at figure 1*g*. As in the other species of this genus, the opening of the spiracle is surrounded in each case with a number of spinnerets. The anal ring (Fig. 1*h*) consists of four plates, two of which bear three spines each, and two two spines each. Surrounding the anal ring is a pair of chitinous pieces forming a ring. This second ring I have observed in many genera of this family, and I believe the number and shape of the plates of which it is composed will be found to afford generic characters. These two rings are partially surrounded by a fringe of plates and teeth (Fig. 1*f*).

A NEW WAX INSECT

In the old collection of the Department of Agriculture I found several twigs of oak bearing large masses of bright yellow, and nearly spherical, sac-like bodies which appear to be largely composed of wax. Each of the sac-like bodies contained the shriveled remains of an insect which evidently excreted it, and which proves to belong to an undescribed genus of the Coccinae. The twigs of oak belong to two species, native of Arizona, *Quercus oblongifolia* and *Quercus undulata,* variety *Wrightii.* I have also specimens of the same insect from the Museum of Comparative Zoology infesting what is probably *Quercus agrifolia,* and which were collected in California by Osten-Sacken.

Judging from the specimens before me, this insect occurs in sufficiently great numbers to be of economic importance if the excretion can be utilized as is the excretion of an allied insect which produces the true white wax of commerce. The matter is now being investigated by the chemist of the Cornell University Experiment Station, and will probably be discussed in the next report of that institution.

I submit the following characterization of the genus to which this insect belongs:

Genus **CEROCOCCUS**, new genus

Adult female apodous; body covered with a layer of waxy excretion, which forms a continuous sheet, not composed of a number of plates more or less closely united, as in Ceroplastes. The excretion forms a complete sac about the body of the insect. At the caudal end of this sac there is an opening; and on the dorsal part near the center the larval skin is imbedded but plainly visible. The adult female is provided with spinnerets of two kinds, which may be designated as double pores and simple pores, respectively. Anal segment with the two caudal lobes characteristic of the Coccinae; anal ring with eight spines; anal plate of a single piece, and situated dorso-caudad of anal ring. Mentum of two segments.

CEROCOCCUS QUERCUS, new species (Plate XX, figs. 2–2*e*)

Sac of female.— The sac in which the body is inclosed is bright yellow in color, elliptical in outline, very convex above. The lateral margin bears a row of tubercles which evidently correspond to the segments of

the body. Length 6 mm. (.24 inch), width 5 mm. (.2 inch). Usually these sacs are more or less massed around the twig (Plate XX, fig. 2).

The form of the sac of the immature female is represented by figure 2*b*. The larval skin occupies the center of the dorsal surface, and the excretion forms a thick ring around this skin.

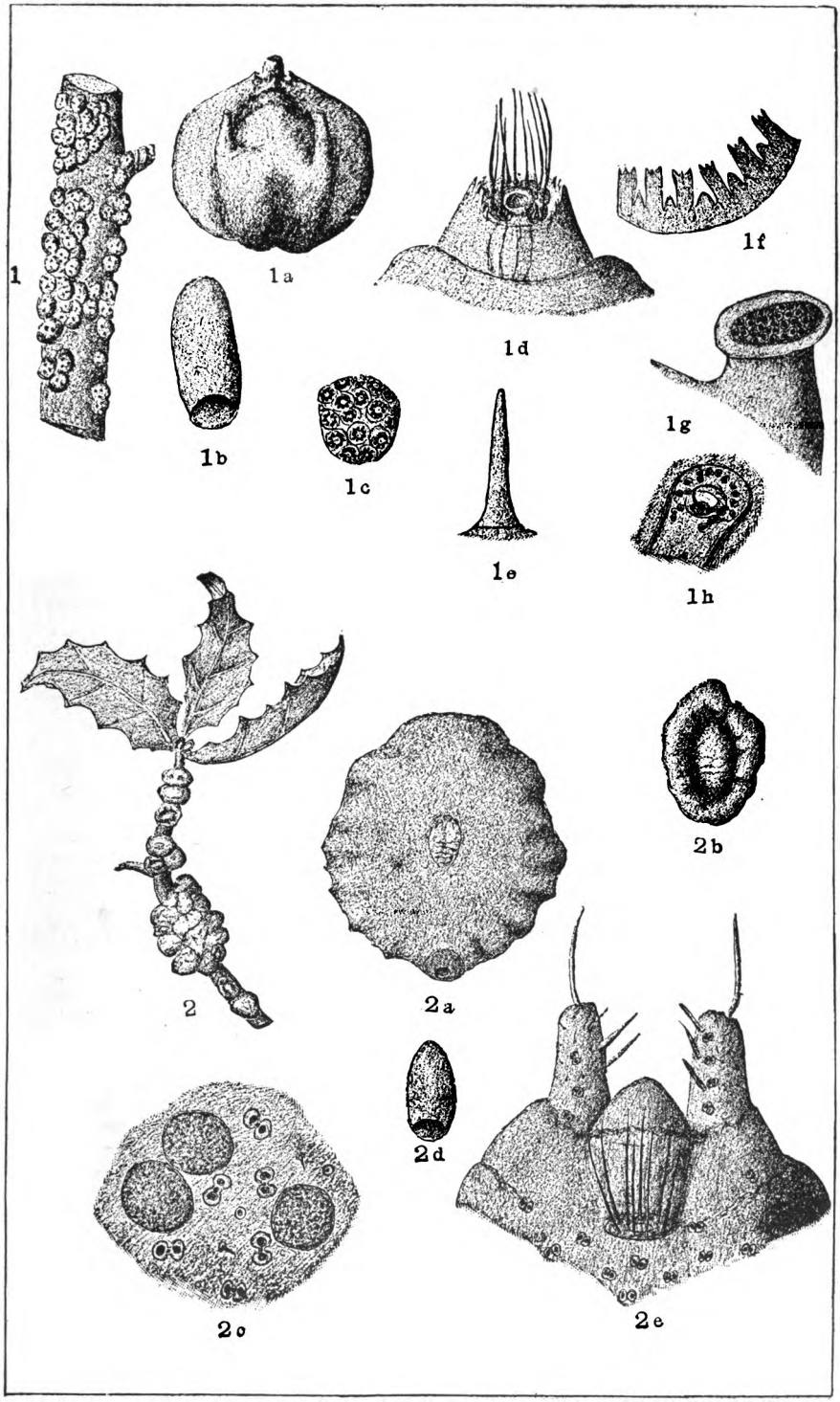
Female.— The body of the female is elliptical in outline, with neither legs nor antennæ. The caudal end of the body is terminated by two prominent lobes (Fig. 2*e*), each of which bears a long terminal bristle and several shorter ones. The anal ring is situated in a deep depression, from which the spines of the ring hardly project. This is represented in optical section in figure 2*e*. Dorso-caudad of the anal ring, near the opening of the depression in which this ring is situated, is the anal plate. The edge of it is represented as a line extending from the base of one lobe to the other in figure 2*e*. Scattered over the surface of the body are a large number of paired pores. These are represented in figures 2*e* and 2*c*. A few single pores occur also. Near the caudal end of the body there are several round bodies, which I have termed the madreporiform bodies (Fig. 2*c*).

Sac of male.— The sac of the male is oval, with an opening at one end from which the male emerged (Fig. 2*d*). The male was not observed.

NOTE ON THE STRUCTURE OF MEALY BUGS

In Dactylopius, and presumably in other genera of the Coccinae, the opening of the oviduct is distinct from that of the posterior end of the alimentary canal, being on the ventral side between the sixth and seventh abdominal segments. I have watched a female during the act of depositing, so there is no doubt respecting this matter. Consequently the expression *ano-genital ring,* which has been applied by authors to the ring of hairs and spinnerets at the caudal end of the body, is not correct. The term *anal ring* is the appropriate one.

We have also observed in Dactylopius a pair of openings on the dorsal side of the sixth abdominal segment, which are evidently homologous with the honey tubes of the Aphididae. A female mealy bug was gently rubbed near the caudal end of the body, when suddenly there appeared two drops of a clear fluid, resembling in appearance the honey-dew of plant lice. This experiment was repeated many times and with many specimens. Mr. Pergande assures me that he has observed a similar excretion from a pair of openings on the cephalic margin of the first thoracic segment also.



(Plate XXXII, Cornell series)

REPORT OF THE DEPARTMENT OF ENTOMOLOGY

PROFESSOR J. HENRY COMSTOCK

(From the Second Report of the Cornell University Experiment Station, 1883)

The work of the Entomological Department of this Station, during the past year, has been a continuation of certain investigations begun by the writer while Entomologist to the United States Department of Agriculture. Pecuniary aid in carrying on these investigations was received from that Department; and a report embodying the results was submitted to the Commissioner of Agriculture. Owing to the limits of the space which could be given to Entomology in the Annual Report of the U. S. Department of Agriculture, only a part of the writer's report was published in that place; the remainder of it is now offered to the public.*

* The following is a list of the topics discussed by the writer in that part of his report which is published in the Annual Report of the U. S. Department of Agriculture for 1881:

THE APPLE MAGGOT (*Trypeta pomonella* Walsh). A white cylindrical maggot which eats into the pulp of apples causing them to decay, and which when fully grown goes into the ground to transform. The adult is a black and white fly with banded wings.

THE VINE-LOVING POMACE FLY (*Drosophila ampelophila* Loew). A small white maggot, found abundantly in decaying apples, and producing a small, clear-winged, red-eyed fly. This insect is found about cider mills and wine cellars, where it becomes a nuisance. It is said also to infest grapes while hanging on the vines.

THE PRETTY POMACE FLY (*Drosophila amoena* Loew). A small white maggot, resembling the larva of the Vine-loving Pomace Fly, and, like that species, found in decaying apples; but unlike that species going into the ground to transform, and developing into a red-eyed fly with black spots on its wings.

THE OCELLATE LEAF GALL OF RED MAPLE (*Sciara ocellaris* O. S.). Circular ocellate spots, on the leaves of the red maple (*Acer rubrum*) about three-eighths inch in diameter, with disk yellow, and margin and central dot, during one stage of their growth cherry red.

In submitting this report I wish to acknowledge the assistance in the preparation of material for it, of Mr. Henry Ward Turner and Mrs. Anna B. Comstock. The illustrations have all been drawn from nature by Mrs. Comstock.

A part of the work required in my laboratory of each student in the Course in Agriculture is the making of original investigations respecting the life history of one or more insects injurious to agriculture. I submit, as a supplement to my report, the results of one of these investigations, a study of the Tineidae infesting apple trees at Ithaca, by Mr. A. E. Brunn, of the class of 1882.

SECOND REPORT ON SCALE INSECTS

Including a monograph of the subfamily Diaspinae of the family Coccidae, and a list, with notes, of the other species of scale insects found in North America

INTRODUCTION

Owing to the large number of species of scale insects which have been described, and to the fact that the greater part of the descriptions have been published in journals of limited circulation, it is now impossible, for one who does not make a special study of this family of insects, to determine with certainty the various species belonging to it. I have, therefore, thought best in

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LADYBIRDS (Coccinellidae). Descriptions of the different stages of several species of ladybirds found preying upon insects injurious to vegetation.

METHODS OF DESTROYING SCALE INSECTS. Results of experiments made in California, chiefly with lye.

LAC INSECTS. Descriptions of all the known species of lac insects, three in number. Of these, two are American and are here described for the first time. Lac insects are the insects which produce lac, the substance from which shellac and the lac dyes are made.

A NEW WAX INSECT (*Cerococcus quercus*, new species). A coccid found in Arizona and California which excretes a large amount of wax.

NOTE ON THE STRUCTURE OF MEALY BUGS. On the position of the opening of the oviduct; and on the presence of organs homologous with the honey tubes of the Aphididae.

presenting descriptions of certain new species of the subfamily Diaspinae to give the characters by which the other known American species may be recognized, and thus to place in the hands of the American reader a work which shall represent the present state of our knowledge of this very important group of insects.

In order that the species can be determined with the least possible difficulty, I have carefully prepared analytical tables, and have given figures which represent the distinctive characters of each species.*

As scale insects are permanently attached to the plants which they infest, they are much more liable to be transported from one country to another than are any other insects. For this reason, a work which represents merely the species of a single fauna is very imperfect. The extensive importation of plants and of cuttings renders our plants liable to become infested with scale insects from all parts of the world. I have therefore given the names, and as far as possible the distinctive characters, of the species of the Diaspinae which have been described in other countries. It has been impracticable, however, to introduce such species into the analytical tables without specimens for examination.

CHARACTERS OF THE DIASPINAE

Owing to the great diversity of form and structure among the species belonging to the family Coccidae, or scale insects, this family has been divided into several sections, or subfamilies. This paper is devoted to one of these subfamilies, the Diaspinae.

* It has not seemed worth while to reproduce the figures and descriptions given in my first report on scale insects (Annual Report Department of Agriculture, 1880), as that paper will be accessible to all who care to use this monograph, and may therefore be considered a part of it.

I regret that, owing to my absence from Washington during the printing of that report, there are in the body of it many important typographical errors. These are principally in the references to plates. The explanation of plates on pages 372, 373, is correct; and in this report wherever a reference is made to a species figured in that one, the reference to the plates of that report is corrected if necessary.

This subfamily includes the greater number of the very important pests belonging to the family of scale insects. Familiar examples are the oyster-shell bark louse of the apple, the two red scales of the orange, and the white scale of the oleander. (For the characters of the other subfamilies, as well as for those of the family Coccidae, see my first report on scale insects, pages 277–279.)

The Diaspinae includes those species of scale insects which form a scale composed in part of molted skins and partly of an excretion of the insect. This apparently trivial character is correlated with important structural characters which mark a well-defined group.* The most important of the structural characters is the peculiar form of the last segment of the body. This segment is highly specialized for the excretion and manipulation of wax. It is furnished with many openings and appendages, both of which vary greatly in number and form. None of the species, however, present the peculiar anal plates characteristic of the Lecaninae; nor is the caudal extremity divided into two lobes of the form characteristic of the Coccinae. In the Diaspinae the caudal end of the body is usually terminated by a pair of lobes; but these lobes are of an entirely different structure from the lobes of the Coccinae. (Compare the figures on Plate I of this report with figure 2*e* of Plate XX, Agr. Report for 1881.)

The peculiar characters of the last segment of the body in the Diaspinae are not presented by the larvae till after the first molt, nor by the male after the change to pupa.

EXPLANATION OF TERMS

The members of the subfamily Diaspinae differ so greatly from the ordinary forms of insects that in classifying and describing them it becomes necessary to use characters peculiar to them. These characters are discussed in the Report of the U. S. Department of Agriculture for 1880, pages 281–283, and are figured on

* In the genus Cerococcus which belongs to the Coccinae, the larval skin forms a part of the covering of the insect. A glance, however, at the last segment of the body of one of these insects is sufficient to show that the genus does not belong to the Diaspinae.

Plates I and II of this report. The following are the terms employed in referring to these characters:

I. Scales

Scale.— The term scale is applied to the thin pellicle which covers the dorsal surface of the bodies of all the Diaspinae. It is composed in part of molted skins and partly of an excretion of the insect. (For figures of different forms of scales see Plate II.)

Ventral scale.— In certain species there is a pellicle between the body of the insect and the bark of the plant to which the insect is attached. This I have termed the ventral scale. It varies in thickness from an almost imperceptible film to a scale as thick as the scale proper, or dorsal scale. In certain species of Aspidiotus I have found that it is composed in part of the ventral half of the molted skins; the larval skin splits along the lateral margin of the body, and one-half of it goes to strengthen the dorsal scale and one-half the ventral scale, as with the dorsal scale to these molted skins is added an excretion of the insect.*

Exuviae.— This term is applied to the molted larval skins which form a part of the scale. The size and position of the exuviae are important generic characters (see Plate II). The number of skins in a scale is a sexual character. In the scale of the female (Plate II, figs. 1, 2, 3, etc.), there are two molted skins; in that of the male (Plate II, figs. 1*a*, 2*a*, 3*a*, etc.), there is but one.

II. Last segment of female

Vaginal opening.— Near the center of the ventral surface of this segment there is a large transverse opening; this is the vaginal opening. (See Plate I, *a*, *a*.)

Anus.— The anus is on the dorsal surface of the body; but it is usually visible from the ventral surface, appearing as a transparent circular spot. (Plate I, *b*, *b*.) Its position varies in different

* The only notice that has been made of the ventral scale by previous writers is the establishment of the genus Targionia, by Signoret, for a species in which this scale is greatly developed. This character is, however, evidently not of generic importance. I have before me a series of species of Aspidiotus which shows a gradation from a species in which the ventral scale is imperceptible to one in which it is as thick as in the *Targionia nigra* of Signoret.

species from near the caudal end of the body (Plate I, fig. 1*b*) to a point opposite the penultimate ventral segment (Plate I, fig. 2*b*).

Spinnerets.— There are many openings and tubular appendages of this segment which serve for the emission of the excretion of which the scale is composed; these may be termed spinnerets. In most species there is a greater or less number of peculiar spinnerets arranged in groups around the vaginal orifice (Plate I, *c, d, e*). These spinnerets differ remarkably from others in being compound, each one being a circular plate perforated by several small openings. It is to these compound spinnerets that reference is made in the descriptions by the expression *groups of spinnerets.* In most species the number of the groups of these spinnerets is either four or five. When they are five, one is situated cephalad of the vaginal opening, and two each side of it. These are designated as the *mesal group,* the *cephalo-laterals,* and the *caudo-laterals* respectively.*

Lobes.— These are the most conspicuous of the appendages of this segment. They are represented at f^1, f^2, and f^3 on Plate I. The number of these lobes varies from one pair to six pairs. These pairs of lobes are designated as the first, second, third, etc., beginning with the mesal lobes.

Thickened lateral margin.— In some species a part of the lateral margin of this segment is thickened, appearing to be of the same structure as the lobes (Plate I, fig. 3*g*).

Thickenings of body wall.— In certain species thickenings of the body wall occur near the bases of the lobes but more or less distinct from them. The number, size, and position of these thickenings afford good specific characters. (See Plate I, fig. 3*h*.)

Incisions.— In certain species the caudal margin of the segment is incised two or three times on each side of the meson. These incisions and the edges of them, which are usually thickened, afford characters of importance. (See Plate I, fig. 1*i*, incisions; fig. 1*j*, thickened margins of incisions.)

* In the Report for 1880 these groups were designated as the anterior, anterior laterals, and posterior laterals, respectively.

Spines.— There are several spines situated near the posterior margin of the segment. There are usually two of these associated with each lobe, one on the dorsal surface and one on the ventral. Others are situated at various intervals between the lobes and the penultimate segment. In many instances these spines appear to be tubular; and I have repeatedly seen threads extending from them; hence they are doubtless spinnerets. They may be distinguished from other setiform appendages by their globular base. (See Plate I, *k, k.* The spines are not represented in figure 2 of this plate to avoid complicating the figure.)

Plates.— Under this name I have classed all the remaining appendages which fringe this segment. They are usually long, flattened, and more or less notched or toothed. Sometimes, however, they are hair-like or spine-like; but they never have the globular base characteristic of the true spines. Previous writers have not distinguished between the spines and plates; hence the plates are sometimes described as spines. (For figures of plates see Plate I, *l.*)

Wax ducts.— It often happens, especially in the case of specimens which have been prepared with caustic potash, that the last segment of the body appears to bear on its surface several long hairs with club-shaped bases. Very careful focusing will show that the club-shaped parts of these organs are openings in the body wall, and what appears to be hairs are really organs within the body. These are represented in Plate I, fig. 2*m*. I have not definitely ascertained the function of these organs, but believe them to be wax ducts. They have been described as external appendages of the segment under the name of tubular spinnerets, and are figured by Signoret in several instances as such. A second form of wax ducts which are often mistaken for tubular spinnerets is represented at m^1.

Elongated pores.— In certain species there are peculiar openings each situated in a prolongation of the margin of the body. These are slit-like in form and are described as elongated pores. (See figure 2*n* of the plate, where some are represented with wax ducts leading to them.)

III. Terms denoting position or direction of parts

For indicating the position and direction of parts the well-known adjectives *dorsal, ventral, lateral, cephalic, caudal, proximal,* and *distal* are used in preference to less definite terms; as are also the corresponding but less familiar adverbial forms, *dorsad, ventrad,* and so forth. When the position or direction of a part is referred to the middle line of the body (the *meson*), the adjective *mesal* or the adverb *mesad* is used.*

METHODS OF STUDY OF SCALE INSECTS

The scales of the scale insects are among the easiest of all entomological specimens to be preserved. As a rule all that is necessary is to dry the leaf, twig, or bit of bark upon which the insects are. It may then be pinned into a cabinet and the scales preserved indefinitely without further preparation.

The adult females of Diaspinae are also easily preserved in the same way in sufficiently good state for specific identification. Although the body in drying shrivels greatly, the last segment, which presents the important characters, will retain its form indefinitely. It is better, however, to remove the insect while it is fresh from under the scale and to mount it in glycerin or Canada balsam for microscopic study. In many cases tolerably good work can be done with specimens simply mounted without previous preparation. But very much better results can be obtained by first boiling the insect in a solution of caustic potash, and then mounting in glycerin. In fact it is often impossible to observe the groups of spinnerets until after the insect has been prepared in this manner. The necessity of this treatment is probably due to the large amount of excretion with which the openings and appendages of this segment are covered. It is very difficult to preserve the males in good condition. I have had the best results with glycerin.

* For a full discussion of the Anatomical Nomenclature as applied to Entomology, see the writer's *Guide to Practical Work in Elementary Entomology.* Published at Cornell University, Ithaca, New York.

OTHER TOPICS

For a discussion of the following-named topics see Report of the U. S. Department of Agriculture for 1880:

Metamorphoses of the Diaspinae, pp. 279–283.

Methods of preventing the spread of scale insects, pp. 284–285.

Methods of destroying scale insects, pp. 285–290.

Useful products of the Coccidae, p. 291.

CLASSIFICATION OF THE SUBFAMILY DIASPINAE

The genera of the true scale insects, or Diaspinae, which are represented in North America, may be determined by the following table:

A. Scale of female circular, with the exuviae either central or more or less nearly marginal.

B. Scale of male but little elongated, with the exuviae more or less central; scale usually resembling that of the female in color and texture (Plate II, figs. 1*a* and 2*a*). **Aspidiotus.**

BB. Scale of male elongated, with the exuviae at one extremity.

C. Scale of male white and carinated (Plate II, fig. 3*a*). **Diaspis.**

CC. Scale of male not white and with no central carina (Plate II, fig. 6*a*). **Parlatoria.**

AA. Scale of female elongated, with the exuviae at one extremity.

D. Exuviae small.

E. Scale of male white and carinated* (Plate II, fig. 4*a*); last segment of female with five groups of spinnerets. **Chionaspis.**

EE. Scale of male white, but not carinated; female with eight groups of spinnerets (Fig. 15). **Poliaspis.**

EEE. Scale of male similar in form to that of the female (Plate II, fig. 5*a*). **Mytilaspis.**

DD. Exuviae large.

F. Two molted skins visible on the scale of the female (Plate II, figs. 7 and 8). **Parlatoria.**

FF. Second skin covered by a secretion (Plate I, fig. 9). **Uhleria.**

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* In *Chionaspis ortholobis* Comstock the scale of the male is not carinated. This species infests willow in California.

Genus **ASPIDIOTUS** Bouché

Bouché, Naturgeschichte der Garten Ins. 1833, p. 52

This genus includes species of Diaspinae in which the scale of the female is circular or nearly so, with the exuviae at or near the center; and the scale of the male somewhat elongated, with the larval skin at one side of the center, or near one extremity.

The last segment of the female usually presents four groups of spinnerets; in some species there are five groups; in a few there are none; and in one, now placed in this genus provisionally, there are six groups.

Two types of the scale of the female exist. In one, the exuviae are covered by excretion, and their position is indicated by a nipple-like prominence which is often marked with a central white dot and a concentric ring of the same color (Plate II, fig. 1). I have observed this character in no other genus. In the second type the exuviae are naked (Plate II, fig. 2). The species in which the scale of the female is of this kind can be distinguished from Diaspis only by the scale of the male, which is carinated in that genus.

The species of Aspidiotus which have been observed in this country may be distinguished by the following table:

ASPIDIOTUS

A. Last segment of female with six groups of spinnerets. **sabalis.**

AA. Last segment of female with less than six groups of spinnerets.

B. Last segment of female with three pairs of well-developed lobes; and with elongated thickenings of the body wall terminating at or near the bases of the lobes. (See Plate I, fig. 3*h*.)

C. Last segment of female with five groups of spinnerets. **obscurus.**

CC. Last segment of female with four groups of spinnerets.

D. Female with three large compound plates laterad of third lobe. **ficus.**

DD. Female with two small plates laterad of third lobe. **perseae.**

CCC. Last segment of female with no groups of spinnerets.

E. Female with large projection on the cephalic end of body. **personatus.**

EE. Female with cephalic end normal.

F. Female with large plates. **aurantii.**

FF. Female with small plates.

G. Anus not cephalad of club-shaped thickenings between second and third lobes. **tenebricosus.**

GG. Anus cephalad of club-shaped thickenings.

H. Eight club-shaped thickenings laterad of each mesal lobe. **mimosae.**

HH. Only two club-shaped thickenings laterad of each mesal lobe. **similacis.**

BB. Second and third pairs of lobes wanting, or much smaller than the mesal pair; caudal margin of segment with two pairs of incisions, *with thickened edges.* (See Plate I, fig. 1*i*.)

I. Groups of spinnerets wanting.

J. Scale of female very convex. **rapax.**

JJ. Scale of female flat. **perniciosus**

II. Groups of spinnerets present.

K. Scale of female very convex, only four groups of spinnerets.

L. Only two pairs of incisions, plates prominent. **cydoniae.**

LL. A slight incision laterad of each second incision, plates less prominent. **convexus.**

KK. Scale of female flat, species with sometimes a fifth group of spinnerets.

M. With two or three pairs of lobes. **juglans-regiae.**

MM. Second and third pairs of lobes obsolete or wanting.

N. Mesal lobes parallel, and each conspicuously narrowed on each side. **uvae.**

NN. Mesal lobes converging distad, each narrowed but little, if any, on mesal margin. **ancylus.**

BBB. With neither elongated thickenings of the body wall, nor incisions *with thickened edges.*

O. Groups of spinnerets wanting. **abietis.**

OO. Only two groups of spinnerets. **pini.**

OOO. With four groups of spinnerets.

P. Second and third lobes deeply incised, plates simple. **parlatorioides.**

PP. Second and third lobes simple, plates notched and toothed.

Q. Scale of female with larval skin naked. **nerii.**

QQ. Scale of female with exuviae covered.

R. Plates exceeding spines in length. **cyanophyli.**

RR. Dorsal spines of the second and third lobes much longer than the plates. **spinosus.**

THE HEMLOCK SCALE

1. Aspidiotus abietis n. sp. (Fig. 1).

At Ithaca, N. Y., there is a species of Aspidiotus quite common on the lower surface of the leaves of hemlock (*Abies Canadensis*), for which, it being undescribed, I propose the name *abietis.*

Scale of female.— The scale of the female very closely resembles that of *Aspidiotus pini* except that it is usually more nearly circular; this is probably due to the difference in the shape of the leaves which the two species infest. The color of the scale is dark gray, often approaching black, with the margin lighter, and sometimes with a bluish, brownish, or purplish tinge. As with *A. pini,* in many specimens of the fully formed scale the part covering the exuviae is more or less distinct, appearing like a small scale with a light margin superimposed upon a larger scale. Length of scale, 1.3 to 2 mm. (.05 to .08 inch); width about nine-tenths of the length.

Female.— The last segment of the female presents the following characters:

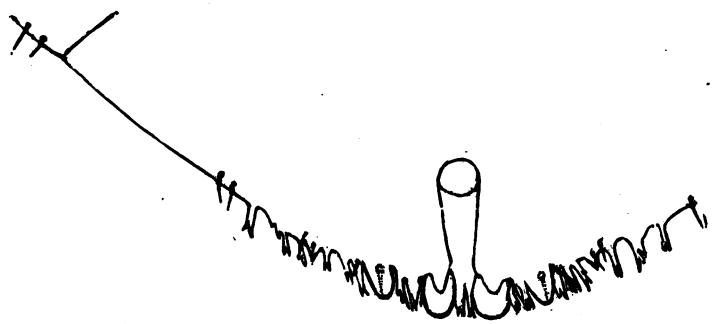


FIG. 1 (Fig. 93, Cornell series)

The *groups of spinnerets* are wanting.

The mesal and second *lobes* are well developed; their distal extremities are rounded; the third lobe of each side is small and acutely pointed.

The *plates* are rather short and irregularly fringed; there are two between the mesal lobes; two between each mesal and second lobe; three between each second and third lobe; and usually three laterad of each third lobe.

The *spines* of the dorsal surface are as follows: one laterad of each mesal lobe; one upon each second and third lobe; and one laterad of the most lateral plate. Each ventral spine with the exception of the first, which is wanting, is situated laterad of the corresponding dorsal spine.

Scale of male.— The scale of the male is as wide as that of the female and a little longer. It resembles that of the female in color.

Male.— The male is of bright orange color with the thoracic band very dark brown, nearly black.

Described from many specimens of each sex.

PUTNAM'S SCALE

2. Aspidiotus ancylus Putnam.

Diaspis ancylus Putnam. Trans. Iowa State Hort. Soc. 1877, p. 321.
Aspidiotus ancylus Putnam. Proc. Davenport Academy, Vol. II, p. 346.

This species infests many plants. We have found it upon ash,

beech, bladder nut, hackberry, linden, maple, oak, osage orange, peach, and water locust. It was first described from specimens found in Iowa. We have also observed it in New York and in the District of Columbia.

For description and figures of this insect, see Agr. Report 1880, page 292.

From this species I have bred the hymenopterous parasite *Cocophagus varicornis* Howard, described in Agr. Report 1880, page 360.

THE RED SCALE OF CALIFORNIA

3. Aspidiotus aurantii Maskell.

Aspidiotus aurantii Maskell. Trans. and Proc. New Zealand Institute, vol. xi, p. 199.

Aspidiotus citri Comstock. Canadian Entomologist, vol. xiii, p. 8.

This species is the most important insect infesting orange and lemon trees in California. It has been introduced into that State from Australia.

For descriptions and figures of the different stages of this insect, see Agr. Report 1880, pages 293–295. Make following corrections in that report: page 293, line 29, for Plate XIV read Plate XIII; page 294, line 34, for Plate XIII read Plate III.

THE CONVEX SCALE

4. Aspidiotus convexus Comstock.

This species infests willows and poplar in California. For description and figure, see Agr. Report 1880, page 295.

THE CYANOPHYLLUM SCALE

5. Aspidiotus cyanophylli Signoret (Fig. 2).

Aspidiotus cyanophylli Signoret. Essai, 1869, 119.

Upon certain species of fig (*Ficus indica* and *Ficus laurifolia*), in conservatories at Washington and at Cambridge, Mass., I have found a species of Aspidiotus which I believe to be the same as

that described by Signoret as infesting *Cyanophyllum magnificum* at Paris.

Scale of female.— The scale of the female is circular, and brownish yellow, with the exuviae central, and bright yellow. The exuviae are, however, normally covered with a nipple-like mass of white excretion.

Female.— The body of the female is lemon-yellow, with the last segment brownish.

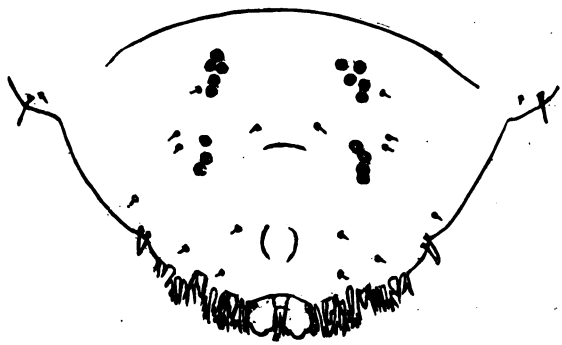


FIG. 2 (Fig. 94, Cornell series)

There are four *groups of spinnerets*; the cephalo-laterals consist each of four or five; the caudo-laterals of three to five.

The mesal *lobes* are large; each is suddenly narrowed on both sides near the distal end; the second lobe of each side is long and slender, appearing much like a plate; the third lobe is similar in shape but smaller.

The *plates* are very long and usually deeply incised; in each case they extend beyond the lobes. There are two between the mesal lobes, with the distal ends incised; two similar ones between each mesal and second lobe, of these the mesal plate is the more delicate; three between each second and third lobe, these are deeply incised on their lateral margins. Laterad of the third lobe there are usually five or more plates, some of which are simple and some branched.

The *spines* are very long and slender; they do not, however, exceed the plates in length. The spines of the dorsal surface are

as follows: one on the lateral part of the base of each mesal lobe: one on each second lobe; one laterad of each third lobe; and one at about one-third the distance from the third lobe to the penultimate segment. Each ventral spine excepting the first pair, which are wanting, is situated laterad of the corresponding dorsal spine. Other small spines scattered over the surface of the segment and visible in specimens prepared with caustic potash are represented in the figure.

THE QUINCE SCALE

6. Aspidiotus cydoniae Comstock.

This species I found upon quince in Florida. It is described with figure in Agr. Report 1880, page 295.

THE RED SCALE OF FLORIDA

7. Aspidiotus ficus (Riley MSS).

Chrysomphalus ficus Riley MSS., Ashmead, American Entomologist, 1880, p. 267.

Aspidiotus ficus Comstock, Canadian Entomologist, Vol. XIII, p. 8.

The specific name *ficus* was proposed for this species by Professor Riley because he had found the insect quite injurious to *Ficus nitida*. The species has, however, attracted much more attention as an enemy of the orange. As yet I have only seen specimens from Florida and Cuba. In the Agr. Report for 1880, pages 296–300, I have given descriptions of both sexes and all stages of this insect. In the same report, Plate III, figures 2, 2*a*–2*f*, represent the scales and young; Plate XXI, figure 3, male; Plate XII, figure 2, last segment of female; and Plate XIII, figure 2, margin of last segment of female.

THE ENGLISH WALNUT SCALE

8. Aspidiotus juglans-regiae Comstock.

This species was described from specimens found upon English walnut in California. I afterwards found specimens upon locust,

pear, and cherry in New York and District of Columbia. See Agr. Report 1880, page 300, for description and figure.

THE MIMOSA SCALE

9. Aspidiotus mimosae n. sp. (Fig. 3).

Upon a twig of mimosa from Tampico, Mexico, the same twig that bore the lac insects (*Carteria mexicana*), described by me elsewhere, I found an undescribed species of Aspidiotus.

Scale of female.— The scale of this species very closely resembles that of *A. tenebricosus*. It is very dark gray, agreeing in color with the bark to which it is attached. It is quite convex with the exuviae central. The protuberance indicating the position of the exuviae is marked with a white dot and concentric ring.

Female (Fig. 3).— The last segment of the female presents no *groups of spinnerets.*

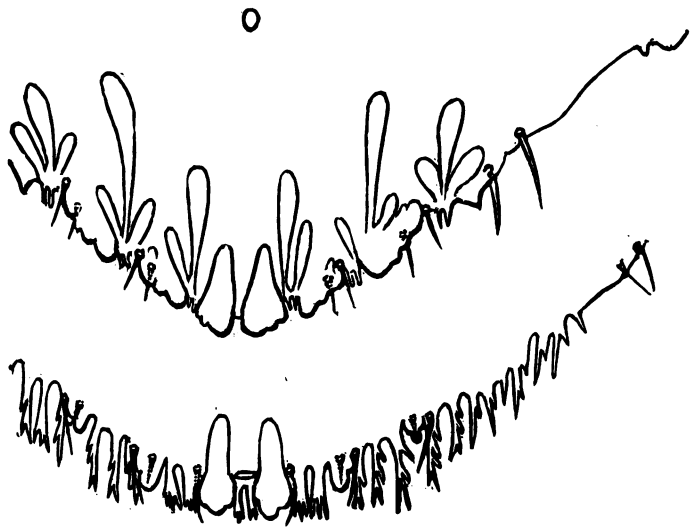
There are three pairs of well-developed *lobes*; the mesal lobes are rounded caudad, but usually with two notches on the lateral margin, and taper to a point cephalad; each second lobe bears two and sometimes three notches on its caudo-lateral margin; the third lobe is larger than the second and bears three notches. A short distance laterad of the third lobe the margin of the segment is prolonged into a triangular fourth lobe.

The *plates* are very inconspicuous, being invisible in many specimens. They are short and simple; there are two between the mesal lobes; and two laterad of each of the mesal, second, and third lobes.

There is a *spine* on the dorsal surface of each of the second, third, and fourth lobes, and one on each lateral margin near the penultimate segment. On the ventral surface there is a spine a short distance laterad of each of the dorsal spines.

There are two club-shaped *thickenings* between each first and second lobes, of which the mesal is the longer; three between the second and third lobes, of these the intermediate one is the longest, and in some specimens the mesal one is wanting; and three between the third and fourth lobes.

Described from fifteen females.



FIGS. 3 AND 4 (Figs. 95 and 96, Cornell series)

THE OLEANDER SCALE

10. Aspidiotus nerii Bouché (Fig. 4).

Aspidiotus nerii Bouché, Schädl. Gard. Inst. (1833), 52.
Diaspis bouchéi Targioni-Tozzetti (1867), Stud. sul. Coccin.

This species infests a great variety of plants, and is to be found throughout our country from the Great Lakes to the Gulf of Mexico and from the Atlantic to the Pacific. I have studied it upon the following-named plants: acacia, cherry, currant, "China tree," English ivy, grass and clover growing in pots with orange trees upon which I was rearing this insect, lemons from the Mediterranean, lemons from California, maple, Melia, oleander, plum, and yucca. I am indebted to Dr. E. L. Mark and Mons. V. Signoret for European specimens of this species for comparison with American specimens. The male, female, and scale of each sex are described and figured in Agr. Report 1880, pages 301–303; and in this report figure 4 represents the margin of last segment of female.

THE OBSCURE SCALE

11. Aspidiotus obscurus Comstock.

This is an inconspicuous species which occurs on the bark of the limbs of willow oak at Washington, D. C. For description and figures, see Agr. Report 1880, page 303.

THE PARLATORIA-LIKE SCALE

12. Aspidiotus (?) parlatorioides n. sp. (Fig. 5).

Upon a leaf of bay tree (*Persea carolinensis*) received from Dr. Turner, of Ft. George, Florida, I find a scale, the generic position of which is very uncertain. I place the species in this genus only provisionally.

Scale of female.— The scale of the female (Plate II, fig. 10) is circular with the exuviae marginal. The exuviae are very large, extending from one margin to the center of the scale. This gives the scale the appearance of a circular Parlatoria, like *P. pergandii*; hence the specific name. The color of the scale is light yellow; the exuviae are of a similar color with a brownish tinge. Diameter of scale, about 1.4 mm. (.055 inch).

FIG. 5 (Fig. 97, Cornell series)

Female.— There are four *groups of spinnerets*; the cephalo-laterals consist of nine to fifteen, usually nine; the caudo-laterals of seven to ten, usually nine.

The mesal *lobes* are wide, their sides are parallel, and each is abruptly narrowed on each side near the distal end. The second and third lobes are deeply incised; when these lobes are well-developed each lobelet usually bears a slight notch on its lateral margin. The third pair of lobes is often obsolete.

The *plates* are simple, and taper to a point. There are two between the mesal lobes; one laterad of each of the second and third lobes. On the margin of the segment between the third lobe of each side and the penultimate segment are two pairs of short projections; these may be rudimentary plates.

The *spines* of the dorsal surface are as follows: one at the base of the mesal side of each of the mesal lobes; these spines are long, extending beyond the plates; one between the lobelets of each of the second and third lobes; and one near each pair of the rudimentary plates. The ventral spines are very delicate; there is one laterad of each of the second and third lobes, and one laterad of each of the pairs of rudimentary plates.

The male is unknown. The form of the scale of the male will doubtless determine definitely the generic position of the species.

THE PERNICIOUS SCALE

13. Aspidiotus perniciosus Comstock.

This species I believe to be the most injurious scale insect found in our country. As yet I have found it only in California; and in that State it is most abundant in the Santa Clara Valley. It infests nearly all of the deciduous fruits grown in California. It has not been observed on citrus trees; hence the orange growers will consider it much less pernicious than the red scale (*Aspidiotus aurantii*). For description and figures, see Agr. Report 1880, page 304.

THE RED BAY SCALE

14. Aspidiotus perseae Comstock.

This is an insect which infests the red bay (*Persea carolinensis*) in Florida. For description and figures, see Agr. Report 1880, page 305.

THE MASKED SCALE INSECT

15. Aspidiotus personatus n. sp. (Plate III, figs. 2 and 2*a*).

This is a Cuban species which infests the leaves of various trees and shrubs in the public gardens of Havana. I am indebted to Mr. B. W. Law, of that city, for the specimens from which this description is drawn.

Scale of female.— The scale of the female is circular, very convex, with the exuviae central. The scale is dark gray or black, with the exuviae shining black. The position of the exuviae is usually marked with a white dot and a concentric ring of the same color. Ventral scale well developed.

Female.— The body of the female is very thick, completely filling the unusually convex scale. The most striking characteristic of this insect, however, is a large projection of the cephalic end of the body (Plate III, fig. 2). It is this character that suggested the specific name.

The last segment presents the following characters (Plate III, figs. 2 and 2*a*):

There are no *groups of spinnerets.*

There are six pairs of *lobes.* That is, in addition to the three pairs of true lobes there are on each side three lobe-like prolongations of the margin of the segment. The lobes of each side are as follows: the first, or mesal, lobe is pointed and often bears a notch on its disto-lateral margin; the second is smaller than the first and usually bears two notches on its corresponding margin; the third is larger than the first and bears three notches; the fourth lobe is largest of all and bears from four to eight notches; the fifth is smaller than the third; and the sixth is a mere point.

There are many *thickenings of the body wall* along the margin of the last segment. Those of either side are as follows: the first and second lobes are much prolonged cephalad; the third and fourth lobes each have two shorter prolongations; between the first and second lobe is a narrow thickening which extends farther cephalad than any other; between the second and third lobe is one, which is but little shorter; between the third and

fourth lobes are two still shorter; and laterad of the fourth lobe are many very short ones.

The *plates* are short and delicate; but they are remarkably constant in shape and number. There is one between the mesal lobes which is bifurcated; two laterad of each of the mesal and second lobes, in each case the mesal plate of the two is usually bifurcated; and three laterad of the third lobe of each side, of these the mesal one is simple and the lateral two bifurcated.

There are two delicate *spines,* one on the dorsal surface and one on the ventral laterad of the sixth lobe of each side. The spines of the other lobes are obsolete or wanting.

THE ASPIDIOTUS OF PINE

16. Aspidiotus pini Comstock.

This species infests the leaves of pine. For description and figures, see Agr. Report 1880, page 306.

THE GREEDY SCALE INSECT

17. Aspidiotus rapax Comstock.

Like the pernicious scale insect (*Aspidiotus perniciosus*), this species infests many different plants; and sometimes it occurs in such great numbers as to be very destructive. This is especially the case on euonymus in hothouses in the North or in the open air in the South; and in California on olive and mountain laurel (*Umbellularia californica*). I have also found it on the following-named plants in California: almond, quince, fig, willow, eucalyptus, acacia, and locust. For descriptions and figures, see Agr. Report 1880, page 307.

From this species I bred the chalcid parasite *Aphelinus fuscipennis* Howard, described in Agr. Report 1880, page 356.

THE PALMETTO SCALE

18. Aspidiotus (?) sabalis n. sp. (Plate III, figs. 1–1*c*).

This species infests the leaves of palmetto in Florida. It was

received from Dr. Turner, of Ft. George; and I collected it at Sanford.

Scale of female.— The scale of the female is snowy white. It is irregular in outline, but approximately circular. The exuviae vary in position from central to marginal; they are covered, and their position is indicated by a tubercle which is of a deeper white than the remainder of the scale. (See Plate III, fig. 1, the larger scales.)

Female.— The body of the female is white. The last segment presents the following remarkable characters (Plate III, fig. 1*c*):

There are six groups of *spinnerets,* three on each side. The cephalic group of each side consists usually of four; the intermediate group of four to seven; and the caudal group of six to ten.

Neither *lobes* nor *plates* are present. The caudal extremity of the segment is notched so that the segment has the appearance of being terminated by a pair of lobes; but the characteristic structure of these organs is wanting. On the ventral surface there are on each side four small spines, at nearly equal distances from each other, extending from the meson to near the penultimate segment. There are also on each side more nearly on the edge of the segment about five larger spines. The openings on the dorsal surface of the segment are small, and the greater number of them are in four cephalo-caudal lines. These are represented in the figure, as they may be seen from the ventral side in a specimen prepared with caustic potash.

Rudimentary antennae are present in the female (Plate III, fig. 1*b*). The female is viviparous.

Scale of male.— The scale of the male resembles that of the female, except that it is smaller and more elongated. (See Plate III, fig. 1, the smaller scales.)

Male.— The color of the male is yellow. This sex is wingless, and has short spindle-shaped antennae, differing in form from the antennae of any other described male coccid (Plate III, fig. 1*a*).

I place this species in the genus Aspidiotus only provisionally. The absence of lobes and plates from the last segment of the female, the arrangement of the groups of spinnerets and of the openings on the dorsal surface of this segment, the absence of

wings in the male, and the peculiar form of the antennae of the male, constitute a combination of characters which I believe to be of generic importance. But I believe that a thorough revision of the genera of this family will be necessary ere long; and until that is done I think nothing is to be gained by the erection of a genus for a single species which can be placed in an existing genus.

THE SMILAX SCALE

19. Aspidiotus smilacis n. sp. (Fig. 6).

This species was collected by Professor W. Trelease at Woods Holl, Mass. It infests smilax. It is clearly allied to *A. mimosae* and *A. tenebricosus.*

Scale of female.— The scale of the female is circular, with the exuviae central and covered with excretion. It varies in color from a brown to a dark gray, almost black. The position of the exuviae is marked with a white dot and concentric ring of the same color.

Female.— The last segment presents the following characters:

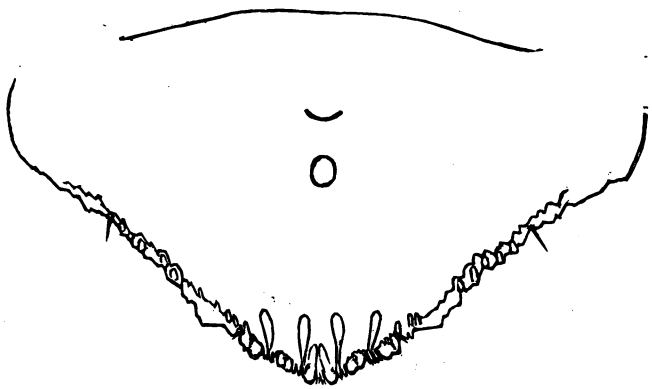


FIG. 6 (Fig. 98, Cornell series)

There are no groups of *spinnerets.*

There are three pairs of well-developed *lobes.* The mesal lobes are the smallest, and are rounded; the second lobe of each side is larger and is notched on its distal margin; the third lobe is sim-

ilar in shape to the second, but it is larger and sometimes it bears two notches instead of one. The margin of the segment laterad of the third lobes is thickened and notched many times.

There are six conspicuous club-shaped *thickenings* of the body wall, three on each side. The first of each side is a prolongation of the mesal lobe; the second is the largest and extends cephalad from a point just laterad of the base of the mesal lobe; the third, which is nearly as large as the second, extends cephalad from between the second and third lobes.

The *plates* are small and are usually notched at the distal end. There are two between the mesal lobes, and two laterad of each mesal and second lobe.

The *spines* are inconspicuous. Each lobe bears one on its dorsal surface, and on the ventral surface there is one laterad of each of the second and third lobes. There is a large slender spine a little more than halfway from the third lobe to the penultimate segment.

THE SPINED SCALE INSECT

20. Aspidiotus spinosus n. sp. (Fig. 7).

This species infests the leaves and branches of camellias in the conservatory of the Department of Agriculture.

Scale of female.— The scale of the female is circular, with the exuviae central and covered with excretion. Color of scale very light brown or dirty white.

Female.— There are four groups of *spinnerets*; the cephalo-laterals consist each of three to six, and the caudo-laterals of four to six.

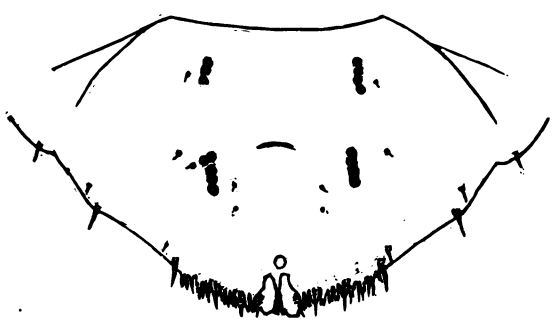


FIG. 7 (Fig. 99, Cornell series)

The mesal *lobes* are quite prominent; each is suddenly narrowed on each side near the distal end. The second and third lobes are small.

The *plates* are of medium size; nearly all of them are more or less notched; there are two between the mesal lobes; two laterad of each mesal lobe; three between the second and third lobe of each side; and usually five or six laterad of the third lobe.

The *spines* on the dorsal surface of the segment are remarkable for their size. Those of each side are as follows: the first is on the lateral part of mesal lobe, and is a little longer than the lobe; the second and third are situated on the second and third lobes respectively, they are very wide, and extend far beyond the lobes; laterad of the lateral plate there is a similar spine. The three spines last described are the largest I ever saw in this genus. There is a fifth spine about midway between the fourth spine and the penultimate segment. The spines of the ventral surface are of the usual size; and excepting the first, which is obsolete, are situated in each case a short distance laterad of the corresponding spine of the dorsal surface.

This species differs from *A. camelliae* (according to Signoret's description of that species) in the great size of the spines, the presence of the groups of spinnerets, and the presence of the second and third pairs of lobes.

THE GLOOMY SCALE

21. Aspidiotus tenebricosus Comstock.

This is a species with a dark inconspicuous scale; it infests red, or swamp, maple (*Acer rubrum*) at Washington, D. C. For description and figures, see Agr. Report 1880, page 308.

THE GRAPE SCALE

22. Aspidiotus uvae Comstock.

This species infests grapevines at Vevay, Ind., and hickory in Florida. For description and figures, see Agr. Report 1880, page 309.

SPECIES OF ASPIDIOTUS NOT YET OBSERVED IN THE UNITED STATES

23. Aspidiotus offinis Targioni-Tozzetti.

Aspidiotus offinis Targ.-Tozz., Catal., p. 45.
Aspidiotus offinis Targ.-Tozz. Signoret, Essai, 1869, p. 114.

This is a species which lives in Italy on *Ruscus aculeatus,* a liliaceous plant belonging to the tribe Asparageae and known as butcher's broom, or knee holly. The following are the more important of the characters given by Targioni-Tozzetti:

The scale of the female is circular, somewhat swollen, with the exuviae central. The female is broadly obovate, rugose above and below. With six lobes, of which the four internal are the largest and are laterally incised, and two are alternating with lacerated and fimbriated scales. Two groups of lateral spinnerets (on each side?). Scale of male depressed, elongated oval.

24. Aspidiotus aloes (Boisduval).

Chermes aloes Boisduval, Ent. Hort. (1867), p. 327.
Aspidiotus aloes Boisd. Signoret, Essai, 1869, p. 114, Pl. III, fig. 1.

This species is found in Europe on the leaves of *Aloe umbellata,* a liliaceous plant resembling the agave, or century plant. The scale of the female resembles much that of *A. nerii*; it is white, circular, with the exuviae central and yellow. The female is greenish yellow, and globular. According to Signoret's figure, the cephalo-lateral groups of spinnerets consist each of four, and the caudo-laterals of nine. The mesal lobes are very large; and there is represented in the figure laterad of each mesal lobe either two incisions or well-developed second and third lobes.

Signoret states that the plants can be easily cleared of this pest by means of a brush, and kept clean by the use of limewater.

25. Aspidiotus atherospermae Maskell.

Aspidiotus atherospermae Maskell. Trans. and Proc. New Zealand Inst., XI, p. 198.

This species is found in New Zealand upon a tree indigenous to that country, the *Atherosperma novae-zealandiae.* The scale of the female is said to resemble that of *A. epidendri* but to be somewhat

darker in color (*A. epidendri* is described by the same writer as flat, of a dirty white color, sometimes brownish, with the exuviae central and yellow). The last segment of the female presents four groups of spinnerets. The cephalo-laterals consist of fifteen, the caudo-laterals of nine or ten. "The abdomen ends in several lobes of which the four middle ones are the largest. The rest of the lobes are sharply pointed. Between the lobes are scaly serrate hairs."

26. Aspidiotus betulae Bärensprung.

Aspidiotus betulae Bärensp., Journal d'Alton et Burm, 1849.
Targioni-Tozzetti, Catal., 1868, p. 43.
Signoret, Essai, 1869, p. 115.

This species infests birch in Europe. The larvae are yellow; the females wine red; the scale round and the color of the bark of birch. These scales are found under the outer loose bark.

27. Aspidiotus budleiae Signoret.

Aspidiotus budleiae Signoret, Essai, 1869, p. 115, Pl. III, fig. 2, Pl. IV, fig. A, B, D.

This species was found in the conservatories of the Luxembourg on the leaves and branches of *Buddleia salicina*, a plant belonging to the order Scrophulariaceae. The scale of the female resembles that of *A. nerii*, being circular, white, with the exuviae central and yellow; the scale of the male is elongated; both turn brown in growing old. The male is clear yellow, a little brownish on the thoracic disk; head notched in front, with four or five hairs in the notch; the thoracic band is shorter than in *A. nerii*, and the angles of the notch of the head are more rounded. The female is nearly circular, of a clear yellow, tinged with orange; the last segment presents four groups of spinnerets; the cephalo-laterals consist of five or six, and the caudo-laterals of three or four.

28. Aspidiotus caldesii Targioni-Tozzetti.

Aspidiotus caldesii Targ., Catal. (1868), p. 43.
A. caldesii Targ.-Tozz. Signoret, Essai, 1869, p. 116.

This species infests the leaves of *Daphne callina* in Europe.

The scale of the female is thin, circular, pellucid, white, with

the exuviae central. The female is broadly obovate, depressed, yellowish green, with two very large lobes and two smaller lateral lobes, and terminated by interposed lacerated and fimbriated plates. Groups of spinnerets wanting, or a few spinnerets which form inconspicuous, slightly interrupted groups. Scale of male white, very thin, elliptical.

29. Aspidiotus camelliae (Boisduval).

Kermes camelliae Boisduval, Ent. Hort., p. 334.
Aspidiotus camelliae Boisd. Signoret, Essai, 1869, p. 117.

This species occurs in various conservatories at Paris upon camellias. The scale of the female is rounded, very convex, and of a more or less transparent yellowish brown. The scale of the male is a little more elongated. The female is rounded like *A. nerii*, but of a more elongated form, and wider posteriorly. The female of this species differs from that of *A. nerii* in that the caudal extremity of the abdomen presents only a single pair of lobes, and the groups of spinnerets are wanting.

30. Aspidiotus ceratoniae Signoret.

Aspidiotus ceratoniae Signoret, Essai, 1869, p. 118, Pl. IV, fig. 2.

This species was collected at Nice on Ceratonia, a plant belonging to the order Leguminosae. It is said to differ from *A. nerii* in the form of the male in which the transverse band of the prothorax is not so pronounced, being almost invisible; the margins of the thorax are more indented; the head presents a notch in front with some hairs; the antennae are long, pubescent, with the two basal segments distinct. The intermediate tibiae, as seen from the side, are narrowed in the middle and enlarged distad; the tarsi are very large.

31. Aspidiotus chamaeropsis Signoret.

Aspidiotus chamaeropsis Signoret, Essai, 1869, p. 118.

This species infests a palm (*Chamaerops australis*). The scale is elongated, transparent, with the exuviae clear yellow and placed upon the side. The female is elongated, yellow; the extremity of the abdomen is terminated by two principal lobes and on each side three to four (*five* according to Signoret's figure) smaller ones. Each

lobe is terminated by a very long hair. There are four groups of spinnerets. The cephalo-laterals consist of three each, and the caudo-laterals of four or five. No plates are represented in Signoret's figure.

Can this be a species of Aspidiotus? The position of the exuviae, and the unusual characters of the last segment of the female, are certainly very different from anything else in this genus. I have not seen specimens.

32. Aspidiotus cycadicola (Boisduval).

Chermes cycadicola Boisd., Ent. Hort. (1867), 344.
Aspidiotus cycadicola Boisd. Signoret. Essai, 1869, p. 119.

This species infests *Cycas revoluta* in Europe. The scale of the female is circular, white, with the exuviae central and yellow. The scale of the male is a little elongated. The female is rounded, yellow; the extremity of the abdomen presents two large mesal lobes; the lateral lobes are smaller; between the lobes are plates; four groups of spinnerets; the cephalo-laterals consist each of ten to twelve, and the caudo-laterals of six to seven. The male differs from that of *A. nerii*, to which it is closely allied, by the large size of the thoracic band which reaches the wings.

33. Aspidiotus denticulatus Targioni-Tozzetti.

Aspidiotus denticulatus Targ.-Tozz., Catal. (1868), 43.

This species infests the leaves of *Rubia peregrina* in Italy. The following characters are given by Targioni-Tozzetti:

Scale of female thin and transparent. Female elongated, with the anterior lobe rounded off, with the entire lobe thinly ciliated, with the posterior triangular subtruncated, with lobes and plates lacerated and toothed, two on each side. Groups of spinnerets wanting; with eight to ten rather large scattered ones.

34. Aspidiotus destructor Signoret.

Aspidiotus destructor Signoret, Essai, 1869, p. 120.

This species occurs on the island of Bourbon in the Indian Ocean, where it is very destructive to cocoa-nut trees. It also infests palms, dates, and *Goyavius psidium* in the same locality.

The scale is circular, of a transparent white, with the exuviae

central and of a transparent yellowish white. The body of the female is circular, yellow, and presents six caudal lobes. The mesal lobes are shorter than the others. There are four groups of spinnerets, each of which consists of eight or ten.

35. Aspidiotus dysoxyli Maskell.

Aspidiotus dysoxyli Maskell. Trans. and Proc. New Zealand Inst., XI. p. 198.

This is a New Zealand species described by Maskell. From its specific name we infer that it infests some species of Dysoxylon, a genus of plants belonging to the Meliaceae, which is represented in this country by the Pride of India, or "China tree." The scale is brown, somewhat convex, the underside white. The female in the middle is bright yellow. There are four groups of spinnerets; the cephalo-laterals consist each of ten, the caudo-laterals of nine. The abdomen ends in six lobes, of which only the two median are conspicuous; between the lobes serrated plates.

36. Aspidiotus epidendri Bouché.

Aspidiotus epidendri Bouché. Ent. Zeit. Stett. (1844), V. 293.
Chermes epidendri Bouché. Boisduval, Ent. Hort. (1867). 339.
Aspidiotus epidendri Bouché. Signoret, Essai, 1869, p. 121.

This species is found upon Epidendrum, a genus of orchids, in the conservatories of Europe. It very closely resembles *A. nerii*; in fact the only characters which have been given which will distinguish this species from that are contained in Signoret's description of the male. According to this writer, the male of this species is more elongated than that of *A. nerii*; the notch in the head is more pronounced; the costal margin of the wings is more hollowed out, and the tubercle of the abdominal style is longer. The legs are also different; the posterior legs have the femora thickened; the tibiae have a deep and long notch at the proximal end, and the tarsi are very large. Signoret gives a beautiful figure of the male (l. c., Plate IV, fig. 1).

37. Aspidiotus ericae (Boisduval).

Chermes ericae Boisduval, Ent. Hort. (1867), p. 330.
Aspidiotus ericae Boisduval. Signoret, Essai, 1869, p. 121.

The above name has been given to a scale insect found upon

heath (*Erica mediterranea*) in France. No characters have been given as yet which will distinguish this species from *A. nerii.*

38. Aspidiotus genistae Westwood.

Aspidiotus genistae Westw., Synop. Gen. Brit. Ins., 118.
Aspidiotus genistae Westw. Signoret, Essai, 1869, 122.
Aspidiotus ulicis Signoret, Essai, 1869, p. 132; 1879, p. 676.

The specific name *genistae* has been given to a species of Aspidiotus which infests Genista, a genus of leguminous plants in Europe. No characters have been given as yet which will distinguish this species from *A. nerii.*

39. Aspidiotus gnidii Signoret.

Aspidiotus gnidii Signoret, Essai, 1869, p. 122.

This species infests *Daphne gnidium* in southern Europe. Signoret states that generally it is smaller than *A. nerii.* This is the only character given in the specific description.

40. Aspidiotus hederae (Vallot).

C. hederae Vallot, Mem. Acad. Dijon (1829).
Aspidiotus hederae Vallot. Signoret, Essai, 1869, p. 122.

This species occurs in Europe upon the leaves of various evergreens, as ivy, holly, and boxwood. The scales are yellowish brown, with the exuviae central and of a clear, more or less transparent, yellow. The abdominal extremity of the female is more elongated than in *A. nerii* and terminated by six lobes, more or less developed; in the notches some simple hairs [plates]; on the disk, near the border, some spinnerets of which the base is rounded and bifid, and terminated by a very long hair. No groups of spinnerets have been observed.

41. Aspidiotus hippocastani Signoret.

Aspidiotus hippocastani Signoret, Essai, 1869, p. 136.

This species infests the horse-chestnut in Europe. The scale of the female is circular, blackish, with the exuviae central and transparent yellow; the scale of the male resembles that of the female but is elongated. The body of the female is circular, and very wide toward the anal extremity. The caudal extremity presents two

large and long lobes with a sinuosity in each side; there are four or five hairs [plates] between the lobes and the penultimate segment. There are, at least, four groups of spinnerets; the cephalo-laterals consist each of eight, the caudo-laterals of eight to ten.

42. Aspidiotus ilicis Signoret.

Aspidiotus ilicis Signoret, Essai, 1869, p. 123.

This scale insect infests a species of live oak (*Quercus ilicis*) in France. The scale of the female is larger and much more convex than that of *A. nerii*; it is grayish yellow, with the exuviae nearly marginal and sometimes forming a black point. The scale of the male is much smaller, a little elongated, and white. The female is of a clear yellow, circular, differing only from *A. nerii* in the isolated spinnerets being less numerous and more difficult to see; in the compound spinnerets being smaller, and the groups consisting of fewer, the cephalo-laterals consisting each of six, and the caudo-laterals of three. The mesal lobes are as large as those of *A. nerii*, and are nearer together; the other lobes are hardly developed; the plates are less numerous; the lateral ones are hair-like. In many individuals Signoret was unable to observe the groups of spinnerets.

43. Aspidiotus kennedyae (Boisduval).

Chermes kennedyae Boisd., Ent. Hort. (1867), 326.
Aspidiotus kennedyae Boisd. Signoret, Essai, 1869, 124.

This is an insect which infests leguminous plants of the genus Kennedya in Australia. The only character given by Boisduval is that it resembles *A. nerii* greatly except that it is a little reddish.

44. Aspidiotus lataniae Signoret.

Aspidiotus lataniae Signoret, Essai, 1869, p. 124.

This species infests Latania, a genus of African palms. The scale is a little elongated, of a clear yellow, translucid at the center, and of a dirty white at the circumference, or at least at the margin of the exuviae. The exuviae are large, and elongated in outline. The female is oval, rounded before, much elongated towards the other extremity; the mesal lobes are large; the

lateral lobes are hardly visible; there are four groups of spinnerets. The cephalo-laterals consist each of three, the caudo-laterals of six to seven; on the margin of the segment a hair [plate] or two.

45. Aspidiotus lentisci Signoret.

Aspidiotus lentisci Signoret, Essai, 1876, p. 601.

"This species resembles greatly *Aspidiotus nerii*. The male and female scales differing from that species only by their yellowish brown color, with the exuviae more clear and brilliant. As to the spinnerets we have found them too variable to enable us to describe them."

46. Aspidiotus limonii Signoret.

Aspidiotus limonii Signoret, Essai, 1869, p. 125.

This species infests lemons, and is said to differ from *Aspidiotus nerii* by the caudal lobes being more detached and more apparent and by the plates being larger; but above all by the more elongated form of the last abdominal segment. The scale of the female is circular, yellowish white, with the exuviae central and yellow; that of the male is more elongated.

47. Aspidiotus myrsinae Signoret.

Aspidiotus myricinae Signoret, Essai, 1869, p. 125.
Aspidiotus myrsinae Signoret, Essai, 1876, p. 670.

This species occurs upon *Myrsina retusa* in the conservatories of the Luxembourg. It is closely related to *A. nerii* in all respects, but differs from that species by the more elongated form of the body, by the more pronounced protuberances or sinuosities on the margin of the body opposite the mouth, and by the smaller number of the compound spinnerets; the cephalo-lateral groups consisting each of four or five, and the caudo-laterals of three or four.

48. Aspidiotus niger Signoret.

Aspidiotus niger Signoret, Essai, 1869, p. 130.

This species infests willow in France. The scale of the female is circular, black, and with the exuviae yellow; the scale of the male is elongated and of the same color. The female is brownish

yellow. The margin of the last segment presents only two lobes and on each side five or six small spiny hairs [plates]. No groups of spinnerets.

49. Aspidiotus oxyacanthae Signoret.

Aspidiotus oxyacanthae Signoret, Essai, 1869, p. 137.

This species infests the English hawthorn (*Crataegus oxyacantha*). The scales are blackish gray, with the exuviae transparent yellow. The scale of the female is circular, that of the male elongated. The extremity of the female presents two quite large lobes with a sinuosity on each side and four or five spiny hairs [plates]. There are five groups of spinnerets. The mesal group consists of four or five; the other four groups, each of ten to twelve.

50. Aspidiotus phormii Breme.

The species is found in Switzerland, upon *Phormium tenax*, a liliaceous plant which furnishes the so-called New Zealand flax. Signoret states (Essai, 1869, p. 130) that the scale of the female is white, circular, with the exuviae central, that of the male a little more elongated. I find no description of the insect itself.

51. Aspidiotus pandani Signoret.

Aspidiotus pandani Signoret,* Essai, 1869, p. 131.

This species is said to live exclusively upon *Pandanus utilis*, an agave-like plant from India. It resembles *A. nerii* much in form, but differs in color, being a blackish brown, with the center whitish. The male has not been described. The female, circular, whitish yellow in color, and presents on the caudal segment four groups of spinnerets. The cephalo-lateral groups consist each of four or five, and the caudo-laterals of three. The yellow color of the female is more or less deep according to age. The segmentation of the body is hardly indicated. The caudal segment

* Signoret describes this species as "*Aspidiotus pannani* Boisduval" (Essai, 1869, p. 131). This is evidently a slip of the pen, as the species is twice referred to in the same monograph (Essai, 1868, p. 863, and 1876, p. 671) as *Aspidiotus pandani* Signoret; and I am unable to find any reference to it in the writings of Boisduval.

presents on its border two mesal lobes, and on each side two lateral lobes. The latter are separated by quite large notches, and in the notches are well-developed plates, the lateral margins of which are serrate. Between the caudal margin and the groups of spinnerets are ten spines, and cephalad of the groups of spinnerets extending in a line across the segment are five groups of what appear to be, according to Signoret's figure, filiform wax ducts.

52. Aspidiotus palmarum Bouché.

Aspidiotus palmarum Bouché, Naturg. Ins. (1834), 1, 17; 5.
Aspidiotus palmatum Blanch., Hist. Nat. (1840), III, 215.
Aspidiotus palmarum Bouché. Signoret, Essai, 1869, 131.

In conservatories and in the open air in southern Europe a species of Aspidiotus is found upon palms which has received the specific name of *palmarum*. According to Signoret the species resembles *A. nerii* very much. The scales are white with the exuviae reddish yellow; those of the female are circular, those of the male elongated. The female is broadly rounded. There are four groups of spinnerets; the cephalo-laterals consist each of ten, the caudo-laterals of seven to eight. Between the caudal margin and the groups of spinnerets are isolated spinnerets [wax ducts] in the form of a tube as with *A. nerii*. The male is larger and more elongated than that of *A. nerii*, and the middle and posterior feet are more sinuous and more notched than in that species.

53. Aspidiotus quercus Signoret.

Aspidiotus quercus Signoret, Essai, 1869, 132.

Upon the leaves and trunk of oak Signoret found a species of Aspidiotus which he described under the name *quercus*. The scales are of a grayish white on the trunk, but a little yellowish upon the leaves. Those of the female are circular, those of the male much elongated, with the exuviae central and yellow. The female is broadly rounded, with four caudal lobes, and on each side some spiny hairs [plates]. There are no groups of spinnerets. The male is short, and of a milky white color. The antennae are short, pubescent; the fourth, fifth, and sixth segments are the largest; the others are almost globular. The head is notched in front, and there are four or five hairs in the notch.

54. Aspidiotus spurcatus Signoret.

Aspidiotus spurcatus Signoret, Essai, 1869, p. 138, Pl. IV, fig. 8.

This species was found by Signoret upon poplar in France. The scale of the female is circular, blackish brown in color, with the exuviae clear yellow. The female is large and circular; when the body is filled with eggs the abdominal segments almost disappear while the head and "breast" become very large. The caudal segment presents five groups of spinnerets, each consisting of a small number, especially the mesal, which consists of only five or six at the most. The mesal lobes are well developed. There are on each side two notches and four or five spine-like plates. The scale of the male is elongated. The male is blunt, short, with short and rounded wings, with short and hairy antennae, and with the thoracic band black. The posterior tibiae are strongly notched near the distal end; and the tarsi are large, flat, and pubescent.

55. Aspidiotus signoreti Comstock (Fig. 8).

Targionia nigra Signoret, Essai, 1870, 106.

Signoret in his monograph of this family (1870, p. 105) establishes the genus Targionia for a species of the Diaspinae which has a complete shell, and describes the species under the name *Targionia nigra*. This species cannot, however, be separated from Aspidiotus. Several species of Aspidiotus have a well-developed ventral scale, so that it may be said that they have a complete shell. Thus in *A. tenebricosus* the ventral scale closely resembles that of the species described by Signoret as *Targionia nigra*. In *A. aurantii* it is more delicate, but in the adult it is so well developed and adheres so firmly to the dorsal scale that it is very difficult to remove the insect from its shell. In *A. rapax* the ventral scale is usually entire and quite conspicuous. In fact we find that in the genus Aspidiotus the ventral scale varies from an imperceptible film to a thickness as great as in Targionia. And as it is impossible to separate those species having a thick ventral scale, or, in other words, those having a complete shell from those that do not, we are forced to the conclusion that the genus Targionia is not a natural one, and that the species described as *T. nigra* must be

placed in Aspidiotus. But the name *nigra* is preoccupied in this genus; I therefore propose the name *signoreti* in honor of the discoverer of this interesting species.

Aspidiotus signoreti infests *Cineraria maritima* (a plant belonging to the Compositae) in France. The scale of the female is black, very convex, rounded, with the exuviae central.

FIG. 8 (Fig. 100, Cornell series)

Figure 8 represents the last segment of the female. The figure was made from specimens kindly furnished me by M. Signoret.

56. Aspidiotus tiliae Signoret.

Aspidiotus tiliae Signoret, Essai, 1869, 137, Pl. IV, fig. 7.

Upon linden or basswood in Europe is found a species of Aspidiotus which is described by Signoret as follows: It resembles *A. nerii*, but may be distinguished from that species by there being only two caudal lobes. The scale of the female is circular, of a deep dirty gray, and with the exuviae central. The female is circular; the caudal segment presents five groups of spinnerets; the mesal group consists of seven or eight, the others of nine to ten each. The border of the segment presents two large median lobes, with some simple sinuosities, and five or six very small spines on each side.

57. Aspidiotus villosus Targioni-Tozzetti.

Aspidiotus villosus Targ.-Tozz., Catal. (1868), 43.
Aspidiotus villosus Targ. Signoret, Essai, 1869, 133, Pl. IV, fig. 6.

This species infests the leaves of olive in Europe. Targioni-Tozzetti gives the following characters: Scale of female circular, grayish, depressed, hairy, exuviae eccentric. Female depressed, with the anterior lobe largest, rounded off. The posterior lobe short, triangular with an obtuse apex.

Signoret states that the groups of spinnerets consist of three each, that there are only two lobes, and that the body is wider towards the caudal end than towards the head.

58. Aspidiotus vitis Signoret.

Aspidiotus vitis Signoret, Ann. Soc. Ent. Fr., Bull. p. LII (1876).
Aspidiotus vitis Signoret, Essai, 1876, 601.

This species infests grapes in the vicinity of Nice, and was found upon raisins from Algiers. The scales are dark gray in color; the exuviae are central and more or less covered. When rubbed the exuviae are brilliant black. The color of the scale is similar to that of the old bark of the vine, so that the presence of the insect is not easily detected except by the white ventral scale which adheres to the plant after the insect has been removed. The female is circular, of a deep grayish brown, with the abdominal extremity clear yellow. Groups of spinnerets were not distinguishable. There is only a single pair of lobes, which are very small; on each side of the lobes are two quite long hairs, and between them and the penultimate segment two smaller ones. The male is of a uniform dark yellow, with the thoracic band dark brown, the eyes black, the wings very long, extending beyond the extremity of the style. The style is long, equaling in length the distance from the thoracic band to the extremity of the last abdominal segment. The antennae are thick and pubescent; the fourth segment is the longest; the third is next; the fifth to the ninth are a little longer than wide, and of equal length; the tenth is very small, hardly longer than the first, which with the second are the smallest.

59. Aspidiotus vriesciae Signoret.

Aspidiotus vriesciae Signoret, Essai, 1869, 134.

In conservatories upon the leaves of *Vriescia splendens,* a plant belonging to the Bromeliaceae, is found this species, which Signoret describes as follows: It is closely allied to *A. nerii,* but is distinguished from that species by the more elongated form of the scales, and the fact that the scales of both sexes are of a uniform yellowish gray. The female is more elongated, less rounded, with the notches deeper, still one can see well only the two mesal lobes, which are large, with one harder, a little indented. There are but few spinnerets in the groups.

60. Aspidiotus zonatus Frauenfeld.

Aspidiotus zonatus Frauenf., Verh. Zool. Bot. Ges. Wien, 1868, 888.
Aspidiotus zonatus F. Signoret, Essai, 1869, 135.

This species was found on an American oak (*Quercus montana*), in the Botanical Garden at Vienna. From the description it is evident that only the males and male scales were seen. The scales when full-grown are 1.8 mm. in length, white with a yellow zone around the side, which is a little elevated. The adult male is yellow with the thoracic band dark red.

Genus **DIASPIS** Costa

Costa Fauna di Napoli, 1836

This genus includes species of Diaspinae in which the scale of the female is circular or nearly so, with the exuviae either central or more or less marginal, and the scale of the male long, white, carinated,* and with the larval skin at one extremity. The last segment of the female presents five groups of spinnerets.

In the scale of the female the exuviae may be either central or marginal or situated at any point between the center and the margin. When the exuviae are central the scale resembles that of these species of Aspidiotus in which the exuviae are naked (e. g., *Aspidiotus nerii,* see Plate II, fig. 2). In such cases the species can be distinguished from Aspidiotus by an examination of the scale of the male, which is carinated in this genus and not in Aspidiotus. When the exuviae are marginal there is nothing to distinguish the species from Chionaspis except the more nearly circular form of the scale of the female in Diaspis; the form of the scale of the male being the same in the two genera. As illustrating this point, compare figure 3 of Plate II with figure 4 of the same plate. Each one is from a camera lucida drawing, the former of *Diaspis rosae,* the latter of *Chionaspis furfurus.* The difference certainly seems very slight, and, as the outline of the scale of the

* In *Diaspis minima* Targ.-Tozz., the scale of the male is said to be without carinae.

female in certain species of each of these genera is very irregular, one can imagine a case in which it would be difficult to determine to which of the two genera a species belonged. But, in fact, I have yet to meet a case where there is any difficulty in distinguishing between Diaspis and Chionaspis.

Six species of Diaspis have been observed in this country. They may be distinguished by the following table:

DIASPIS

Characters from the last segment of the female

A. Groups of spinnerets nearly continuous. **rosae.**
AA. Groups of spinnerets distinct.
B. Margin of segment with incisions. **ostreaeformis.**
BB. Margin of segment without incisions.
C. The third pair of lobes obsolete or wanting. **carueli.**
CC. With three or four pairs of lobes.
D. Mesal lobes attached to segment throughout the entire length of their lateral margins. **boisduvalii.**
DD. Distal extremity of mesal lobes free.
E. Elongated pore between fifth and sixth plates on a large pointed prolongation of the body. **bromeliae.**
EE. Elongated pore between fifth and sixth plates on a more or less rounded and inconspicuous prolongation of the segment. **cacti.**

BOISDUVAL'S SCALE

61. Diaspis boisduvalii Signoret (Fig. 9).

Diaspis boisduvalii Signoret, Essai, 1869, p. 432.

In the conservatory of the Department of Agriculture, on the lower surface of the leaves of a plant known as the traveler's joy (*Ravenala madagascariensis*) and upon a species of Livinstonia, I found a white scale in great numbers. This insect proved to be the *Diaspis boisduvalii* described by Signoret, and which he found infesting the various species of orchids in the conservatories of the Luxembourg. It is probable therefore that this species will be found infesting a variety of plants in greenhouses, and perhaps

even in the open air in the South. The presence of this pest upon the plant was easily detected by discolored spots which it produced in the leaves. These spots are at first yellowish, afterwards becoming dark brown. This insect may be distinguished from the other species of Diaspis which are known to occur in this country by the fact that the scales of the male occur massed in great numbers and the masses are covered with a quantity of loose white hairs.

Scale of female.— The scale of the female is circular or a little elongated, with the exuviae nearly central. The color of the scale varies from white to yellowish gray; the color of the exuviae is similar to that of the scale; in some specimens they are a shade darker. Diameter of scale, 2 mm. (.08 inch).

Female.— The color of the female is lemon-yellow, with the caudal end of the last segment pale brown; the outline of the body is a broad oval, each cephalo-lateral angle of the body is prolonged into a pointed projection. The last segment of the body presents the following characteristics:

FIG. 9 (Fig. 101, Cornell series)

The mesal group of *spinnerets* consist of from eight to fifteen; the cephalo-laterals of from twenty-two to twenty-nine, and the caudo-laterals of from fifteen to eighteen.

The mesal *lobes* are large, wing-shaped, separated at their base, divergent, and attached to the body throughout the entire length of their lateral margins. The second and third lobes of each side are bifurcated; the lobules are subequal and nearly parallel. The fourth lobe is present although rudimentary; its margin is serrate.

The *plates* are simple and spine-like. The first, second, third, and fourth plates are laterad of the first, second, third, and fourth lobes respectively. There are four or five plates, subequally distant from each other, between the fourth plate and the penultimate segment; these plates appear very much like tubular spinnerets.

The *spines* of the ventral surface are situated as follows: the first pair, which are large, project caudad between the mesal lobes; the second and third are mesad of the second and third plates respectively; the fourth between the fourth and fifth plates; and the fifth between the seventh and eighth plates. On the dorsal surface there is a small spine laterad of the caudal end of each mesal lobe; the second and third spines are on the lateral lobules of the second and third lobes respectively; the fourth is mesad of the fourth plate; and the fifth between the sixth and seventh plates.

Laterad of each of the first, second, and third plates the margin of the body is prolonged into a papilla which bears an elongated pore. And between the fifth and sixth plates there is a conspicuous pointed projection, which in color and apparent texture resembles the lobes; this also bears an elongated pore.

Egg.— The eggs are lemon-yellow. A single observation indicates that about sixty eggs are laid by a single female.

Scale of male.— The scale of the male is strongly tricarinated. As indicated above, these scales frequently occur massed in great numbers, and these masses are covered with a quantity of loose curled white hairs. Mixed with these hairs and scattered over the scales is usually a considerable quantity of white powdery substance.

Male.— The color of the male is dark orange; the eyes are dark purple, almost black. The antennae are very long and slender, with the segments of nearly uniform size except the first two and the last.

A large number of the males when they issued became crippled by the woolly secretion which prevented the wings from expanding. It is difficult to see the use of this woolly substance.

The male larvae and pupae resemble the adult in color.

THE PINEAPPLE SCALE

62. Diaspis bromeliae (Kerner) (Fig. 10).

Coccus bromeliae, Naturgeschichte der *Coccus bromeliae,* Stuttgart, 1788.
C. bromeliae, Bouché, Ent. Zeit. Stettin (1844), 295.
C. bromeliae, Bouché, Boisduval, Ent. Hort. (1867), 334.
Diaspis bromeliae, Kerner, Signoret Essai, 1869, 434.

Upon pineapple (*Ananassa sativa*) growing in the conservatory of the Department of Agriculture at Washington and upon *Bilbergia zebrina,* an ornamental plant belonging to the same natural order as the pineapple, I found a species of Diaspis which I believe to be the one which has been so destructive to pineapples in hothouses in Europe. The descriptions in the books of the European species are so general that I do not feel perfectly sure of the identity of our species with that; still I think there is but little doubt.

Boisduval* speaks of this insect as a scourge in the hothouses where pineapples are cultivated, and states that almost always it is necessary to destroy the infested plants in order to avoid contagion, as it is impossible to remove the insects with a brush when they settle within the sheaths of the leaves. But the same writer also states that at Berlin and in Russia they destroy this insect in the pineapple hothouses by using limewater.

Scale of female.— The scale of the female is circular with the exuviae nearly marginal. The scale is white; the exuviae are very light yellow. The first larval skin is usually naked, the second covered with a delicate film. Diameter of scale, 2 to 2.4 mm. (.07 to .09 inch).

Female.— The body of the female is broadly ovate in outline; it is variable in color; it is usually a pale dirty yellow with a faint tinge of purple; some are whitish yellow with irregular pale purplish markings, and others are of a reddish yellow tint. The last segment presents the following characters:

* Essai sur l'Entomologie Horticole, p. 335.

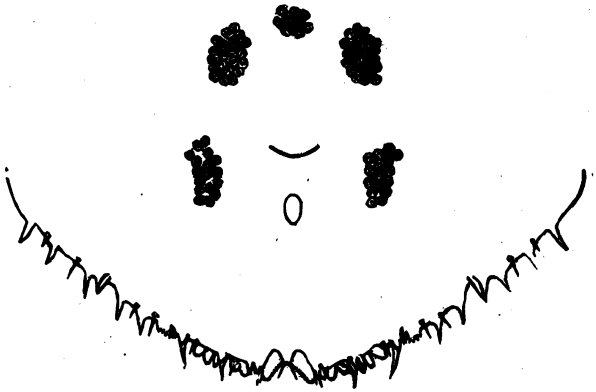


FIG. 10 (Fig. 102, Cornell series)

The mesal group of *spinnerets* consists of from nine to fifteen, usually ten or eleven; the cephalo-laterals, of from twenty to twenty-seven, usually twenty-three; the caudo-laterals of from fifteen to twenty-three, usually sixteen or seventeen.

The mesal *lobes* are small, separated at their base by at least the width of one of them and divergent. In shape and position these lobes resemble much those of *D. boisduvalii* except that the lateral margins of these are not attached to the body throughout their entire length as in *D. boisduvalii.* The second and third lobes of each side are deeply bifurcated, with the lobules divergent; in each case the lateral lobule is more rounded than the mesal one. The fourth lobe is present but much less developed than the other lobes; the lateral margin of this lobe is serrate.

The *plates* are simple and pointed. The first, second, third, and fourth of each side are laterad of the first, second, third, and fourth lobes respectively. There are four or five plates subequally distant from each other between the fourth plate and the penultimate segment.

The *spines* of each side on the ventral surface are situated as follows: first mesad of the first lobe; second, third, and fourth laterad of the second, third, and fourth lobes respectively; and the fifth between the seventh and eighth plates. All the ventral spines are very minute except the first pair, which are very conspicuous.

Of the dorsal spines the first is very delicate and is situated laterad of the first lobe; the second is large and is on the second lobe near its lateral margin; the third and fourth are laterad of the third and fourth lobes respectively; and the fifth is about midway between the sixth and seventh plates.

Between the fifth and sixth plates there is a triangular *prolongation* of the body, which bears an elongated pore.

The penultimate and antepenultimate segments bear plate-like spinnerets.

Egg.— The eggs are yellow; those recently deposited are paler than those ready to hatch. Our observations indicate that a single female lays about one hundred and fifty eggs.

Larva.— The recently hatched larvae are orange-yellow with the eyes dark purplish.

Scale of male.— The scale of the male is strongly tricarinated; the exuviae are yellow.

Male.— The body of the male is orange-yellow; the legs and antennae are light yellow; and the eyes are black. The full-grown larva of this sex is of a dark orange color with very dark purplish eyespots. The last segment is almost colorless; it is narrow, broadening slightly toward the end. The pupa is also orange, with dark purplish eyes and colorless members.

Described from ten females, two males, and many scales of each sex.

Natural enemies.— Many of the scales of the male are pierced with a hole, evidently made by a parasite, which is probably a chalcid.

THE DIASPIS OF CACTUS

63. Diaspis cacti n. sp. (Fig. 11).

In a conservatory at Ithaca, N. Y., I found an undescribed species of Diaspis infesting the cactuses. This insect occurred so abundantly as to necessitate the throwing away of a large number of these plants.

Scale of female.— The scale of the female is circular, with the exuviae nearly central. The color of the scale varies from grayish

white to light green. The exuviae are dark brown, contrasting strongly in color with the remainder of the scale. Diameter of scale, 1.7 mm. (.06 inch).

Female.— The outline of the body of the female is circular; the color is white, tinged with greenish yellow, and with the caudal end brown. The last segment presents the following characters:

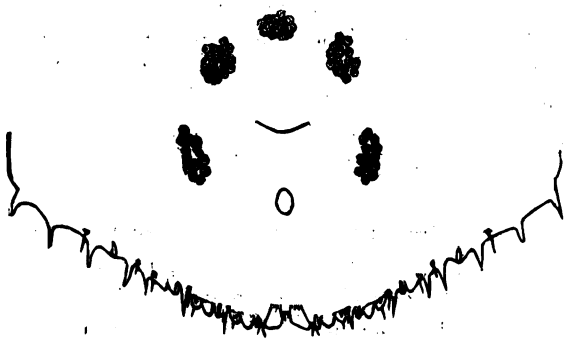


FIG. 11 (Fig. 103, Cornell series)

The mesal group of *spinnerets* consists of from six to thirteen, usually thirteen; the cephalo-laterals, of from thirteen to twenty-two; and the caudo-laterals of from nine to fifteen, usually fourteen.

The mesal *lobes* are small, with their margins entire; they are widest near the middle of their length, and from that point diverge caudad. The second and third lobes of each side are bifurcated; the lobules are subequal and parallel. A rudimentary fourth lobe is present with its margin usually entire, sometimes more or less serrate.

The *plates* are rather stout and conical. The first, second, third, and fourth are laterad of the first, second, third, and fourth lobes respectively; the fourth and fifth are usually nearer each other than any other two; the sixth, seventh, and eighth are usually at subequal distances from each other, although in some specimens two are grouped together.

The *spines* of the ventral surface are usually small in this species, while those of the dorsal surface are large. Those of the ventral

surface are situated as follows: the first pair are between the mesal lobes, but are not so conspicuous as is usual in this genus; the second and third are on the mesal part of the base of the second and third plates respectively; the fourth is between the fourth and fifth plates; we have been unable to discover a sixth ventral spine in this species. On the dorsal surface the first spine is laterad of the first lobe; the second and third, on the lateral part of the lateral lobules of the second and third lobes respectively; the fourth, mesad of the fourth plate; and the fifth, usually laterad of the sixth plate.

Laterad of each of the first, second, and third plates the margin of the body is prolonged into a papilla which bears an elongated pore.

There is a larger projection bearing an elongated pore, between the fifth and sixth plates; this projection is not nearly so long nor pointed as in *D. ananassae* and *D. boisduvalii.*

Scale of male.— The scale of the male is unicarinated, the lateral carinae being obsolete or wanting; the color of the exuviae vary from a transparent yellowish to brown.

Male.— The male has not yet been observed.

Described from twenty females, and many scales of each sex.

There is a closely allied species described by European authors, which also infests cactuses, the *Diaspis calyptroides* of Costa. The two species may be separated by the following table. The characters of *D. calyptroides* are drawn from the excellent description given by Signoret.

D. CACTI	D. CALYPTROIDES
Body of female white tinged with greenish yellow.	Body of female of an orange-red.
Cephalo-lateral group of spinnerets oval or round.	Cephalo-lateral group of spinnerets elongate.
Caudo-lateral group of spinnerets elongate.	Caudo-lateral group of spinnerets more rounded.
Mesal group consisting of six to thirteen spinnerets, usually thirteen.	Mesal group of six to seven.
Cephalo-laterals of thirteen to twenty-two.	Cephalo-laterals of sixteen to eighteen.
Caudo-laterals of nine to fifteen, usually fourteen.	Caudo-laterals of sixteen to eighteen.

Natural enemies.— I have bred a chalcid parasite from *Diaspis cacti,* a species of Aphelinus.

THE JUNIPER SCALE

64. Diaspis carueli Targ.-Tozz.

Diaspis carueli Targioni-Tozzetti, Catal. (1868).
D. carueli Targ.-Tozz. Signoret, Essai, 1869, p. 436.

This insect is very common at Washington, D. C., on various species of juniper and allied plants. For description and figures, see Agr. Report 1880, page 310. In fifth line from bottom of page 310, for Plate XX read Plate XXI.

Natural enemies.— This species is infested by the chalcid parasite *Aphelinus mytilaspidis* LeBaron, which is described and figured in Agr. Report 1880, page 354 (Plate XXIII, fig. 1).

THE PEAR TREE OYSTER SCALE

65. Diaspis ostreaeformis (Curtis).

Aspidiotus ostreaeformis Ruricola [Curtis], Gardeners' Chronicle, 1843, p. 803.
Aspidiotus circularis Fitch, Annual Report N. Y. State Agr. Society, 1856, p. 426.

This is a common species on apple and pear in England; and this year I have received it from the Chief Executive Horticultural Officer of California, Mr. Matthew Cooke, who found it infesting pear trees at Sacramento. It is probable that it occurs also in the Eastern States, as Signoret states that it is the species found by Fitch in New York and described by him under the name of *Aspidiotus circularis.* There is no specimen of the *A. circularis* of Fitch in the collection of the New York State Agricultural Society, and the type in the private collection of Fitch is merely a fragment of a scale gummed to a card. From this fragment it would be impossible to recognize the species. We are therefore forced to accept the conclusion of Signoret, which in all probability is correct, as he corresponded with Dr. Fitch and received specimens of Coccidae from him. For description and figures of this insect, see Agr. Report 1880, page 311.

THE ROSE SCALE

66. Diaspis rosae (Sand.).

Aspidiotus rosae Sandberg (1784), Abhand. Priv. Boh., no. 6, p. 317.
Diaspis rosae Signoret, Essai, 1869, p. 441.

This is a common white scale of the rose which is very widely distributed both in Europe and in this country. I have found it also on raspberries and blackberries. For descriptions and figures, see Agr. Report 1880, page 312.

SPECIES OF DIASPIS NOT YET OBSERVED IN THE UNITED STATES

67. Diaspis blankenhorni Targ.-Tozz.

Diaspis blankenhorni Targioni-Tozzetti, Soc. Ent. Ital. Resocanti, 1879, p. 17.

I have not been able to see the description of this species.

68. Diaspis calyptroides Costa.

Diaspis calyptroides Costa (1827), Faun. Nap., Pl. 6, fig. 2.
Aspidiotus echinocacti Bouché, Schadl. (1833), 53, 3.
D. calyptroides Costa. Signoret, Essai, 1869, p. 434.

This is a very abundant species upon cactuses in Europe, where it has probably been introduced from Mexico. Doubtless the species occurs in conservatories in this country, but I have not yet met it. For the characters by which it may be recognized, see comparison of this species with *Diaspis cacti,* page 93 above.

Targioni-Tozzetti states that the species described by Bouché under the name of *Aspidiotus echinocacti* is identical with this.

69. Diaspis cymbidii Bouché.

Aspidiotus cymbidii Bouché, Ent. Zeit. (1844), V. 296.
Diaspis cymbidii Bouché. Signoret, Essai, 1869, p. 436.

This is a species which infests Cymbidium, a genus of tropical orchids. The description given by Bouché is so general that it only enables one to determine the genus of this insect.

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70. Diaspis juniperi (Bouché).

Aspidiotus juniperi Bouché, Ent. Zeit. Stett., 1851, XII, 111.
Diaspis juniperi Targioni, Cat.

This is a species which infests juniper (*Juniperus communis*) in Europe. Targioni-Tozzetti states that it is distinct from his *D. carueli*; but I know of no description which gives any important characters of the species described by Bouché.

71. Diaspis leperii Signoret.

Diaspis leperii Signoret, Essai, 1869, p. 437.

This is a species which infests peach in Europe. The scale of the female is yellowish gray, with the exuviae yellow, and more or less central. The mesal group of spinnerets consists of eight, the cephalo-laterals of from twelve to thirteen, and the caudo-laterals of eight. The scale of the male is unicarinate. This species will probably be found in this country.

72. Diaspis minima Targ.-Tozz.

Diaspis minima Targioni-Tozzetti, Catal. (1868), 43.
D. minima Targ. Signoret, Essai, 1869, p. 438.

This species infests arbor vitae in Europe. It is evidently very closely allied to *Diaspis carueli*, but is readily distinguished from that species by the form of the scale of the male, whch is described as being without carinae. Signoret states that it is the smallest species known to him.

73. Diaspis visci Schrank.

C. visci Schrank (1781), Enum. Ins. Aust., 296, 588.
Aspidiotus visci Loew, Verh. Zool. Bot. Gesells. zu Wien, XII, 110.
Diaspis visci Schrank. Loew, Verh. Zool. Bot. Ges., XXII, 273.

In Europe on the true mistletoe (*Viscum album*) there is found a species of Diaspis which presents the following characters: The scale of the female is circular with the exuviae central; the scale is white; the exuviae dark yellow or brown. The mesal group of spinnerets consists of from ten to twelve, the cephalo-laterals of from eleven to twelve, and the caudo-laterals of from nine to ten. In the figures given by Loew* only two pairs of lobes are indi-

* Verh. Zool. Bot. Gesells., XXII (1872), Taf. IV.

cated, and the plates are represented as being simple, pointed, and unusually large. The plates are also unusually numerous; in the more carefully drawn figure, seventeen are represented on one side and twenty on the other. The scale of the male is unicarinate.

Genus **CHIONASPIS** Signoret

Signoret, Essai, 1869, p. 442

This genus includes species of Diaspinae in which the scale of the female is long, usually much widened, and with the exuviae at one extremity; the scale of the male is white, carinated (except in *Ch. ortholobis*), with the side parallel, and the larval skin at the cephalic end. The last segment of the female presents five groups of spinnerets.

The scale of the female is always elongated but the outline may be either more or less irregular, as in *Ch. furfurus* (Plate .II, fig. 4), or regular, as in *Ch. pinifolii* (Agr. Report 1880, Plate VI, fig. 2*b*). In the former case it may approach Diaspis; but, as indicated elsewhere, I know of no case in which the scale of a Chionaspis is round enough to be mistaken for a Diaspis, or a Diaspis which is elongated enough to be mistaken for a Chionaspis. In the second case, where the outline is regular, the scale resembles that of a Mytilaspis in shape; but the generic position of the species can be determined by a glance at the scale of the male, which is white and carinated in Chionaspis, and neither white nor carinated in Mytilaspis. In fact, these two genera can in almost all cases be distinguished by the color of the scale. I know of no Mytilaspis in which the scale of either sex is white; and excepting the females of *Ch. euonymi* and *Ch. ficus,* I know of no Chionaspis in which the scale of either sex is not white.

Our species of Chionaspis may be determined by the following table:

A. Scale of female black or blackish brown.

B. Female with groups of spinnerets; plates in twos. **euonymi.**

BB. Female without groups of spinnerets; plates single. **citri.**

AA. Scale of female white or grayish white.

C. Scale of female resembling Mytilaspis in form (i. e., narrow).

D. Exuviae naked; infesting conifers. **pinifolii.**

DD. Second skin more or less covered; infesting grasses. **spartinae.**

CC. Scale of female typical (i. e., much widened).

E. Last segment of female with single mesal lobe. **quercus.**

EE. Last segment of female with a pair of mesal lobes.

F. Body of female yellowish or brownish.

G. Last segment of female with two club-shaped organs cephalad of mesal lobes. **biclavis.**

GG. Last segment of female without club-shaped organs. **nyssae.**

FF. Body of female reddish or purple.

H. Mesal lobes short, broad, and rounded, being nearly circular (Agr. Report 1880, Plate XVI, fig. 3); a single plate laterad of each second and third lobe. **furfurus.**

HH. Mesal lobes longer.

I. Distal ends of mesal lobes pointed or obscurely trilobed (Plate X, fig. 4); a single plate laterad of each second lobe, and usually two plates laterad of each third lobe. **lintneri.**

II. Distal ends of mesal lobes rounded, usually two plates laterad of each second and third lobe (Agr. Report 1880, Plate XVI, figs. 5 and 6).

K. Mesal lobes parallel; scale of male without carinae. **ortholobus.**

KK. Mesal lobes diverging; scale of male tricarinated. **salicis.**

THE MINING SCALE

74. Chionaspis (?) biclavis n. sp. (Fig. 12, and Plate II, fig. 11).

The species for which I propose the specific name *biclavis* and the popular name *the mining scale* occurs in considerable num-

bers in the conservatory of the Department of Agriculture. It has been found upon the following-named plants: *Diospyrus ebenum, Ficus laurifolia,* a species of Tamarindus, and, according to my notes, upon two plants labeled *Ochras sapota* and *Etaecarpus cyanus,* respectively.

This species, of which only the female is known, is remarkable on account of its habit of burrowing beneath the epidermal layer of the leaf or twig which it infests. The color of the scale is white; but this color is almost invariably obscured by the layer of vegetable tissue beneath which the scale is, and which adheres closely to the scale. Figure 11 of Plate II represents a scale taken from a leaf of fig. The position of one of these scales is indicated only by a rust-red elevated spot on the leaf, the dermal layer of the leaf with its hairs being continuous over the surface of the scale. The scales were most abundant on the twigs of *Diospyrus ebenum,* which in some instances were nearly completely covered by it.

Scale of female.—The scale of the female is very nearly circular. On this account I place the species in this genus only provisionally, until the scale of the male is found. The exuviae are marginal and project beyond the edge of the scale, giving the whole scale more nearly the form of Chionaspis than of any other known genus.

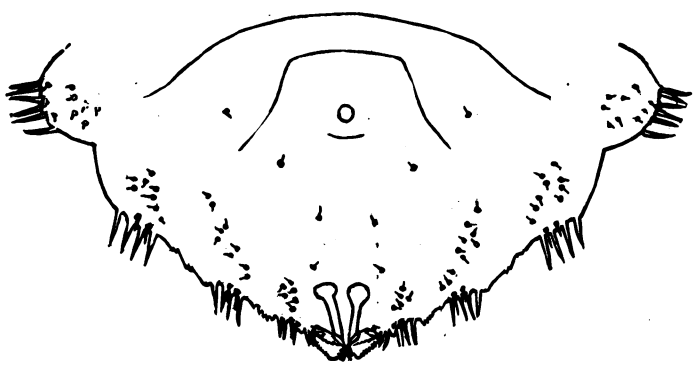

FIG. 12 (Fig. 104, Cornell series)

(99)

Female.— The characters presented by the last segment of the female (Fig. 12) are as unusual as those presented by the scale. The pores on the dorsal surface of the segment are very small. Scattered over the ventral surface are numerous minute spines. The *groups of spinnerets* are wanting.

The mesal *lobes* are large, oblique; nearly twice as broad as long; approximate at the base; the mesal margins diverge slightly; distal margin serrate; meso-distal angle rounded and produced into a lobule. The second lobe is very small, being simply an angular projection of the body wall. The third lobe is about three times as wide as the second lobe, but it projects only a little beyond the margin of the segment.

The *plates* are simple and spine-like. There are two minute ones between mesal lobes; two between first and second lobes; two or three between second and third lobes; a group of three or four larger ones laterad of third lobe; and another group of four or five still larger ones about midway between this group and the penultimate segment. Each of the three segments preceding the last bears on each lateral margin about seven plates.

Two *spines* accompany each group of plates, one on the dorsal surface and one on the ventral. The first and second spines of each side are very small; the third, which is between the second and third lobes, is the largest; the fourth and fifth are successively smaller.

There are two conspicuous *club-shaped organs* which appear like thickenings of the body wall, but which are really within the body cephalad of the mesal lobes. These organs are about three times as long as the mesal lobes; they converge caudad; and the cephalic end of each is suddenly enlarged. This species may be distinguished from any other known American coccid by the presence of these organs.

THE ORANGE CHIONASPIS

75. Chionaspis citri n. sp. (Fig. 13).

Chionaspis euonymi Comstock (in part), Agr. Rept. 1880, p. 313.

In the Report of the Department of Agriculture for 1880 I described a species of Chionaspis which differed from all other spe-

cies of that genus known at that time by the color of the scale of the female, which is black. This species was found on *Euonymus latifolia* at Norfolk, Va. I stated in my account of this insect that it occurred also on orange trees in Louisiana and Cuba. A re-examination of the specimens on orange has convinced me that they are specifically distinct from those on euonymus. I therefore propose for that form the specific name of *citri*. The species can be recognized by the following characters:

Scale of female.— The scale of the female is of a dirty blackish brown color with a gray margin; the exuviae are brownish yellow. There is a central ridge from which the sides of the scale slope like the roof of a house. The greater prominence of this ridge and the more elongated form of the scale are the principal differences between this scale and that of the female of *Ch. euonymi*. There is no danger of its being mistaken for any other known species.

Female.— The last segment of the female presents the following characters:

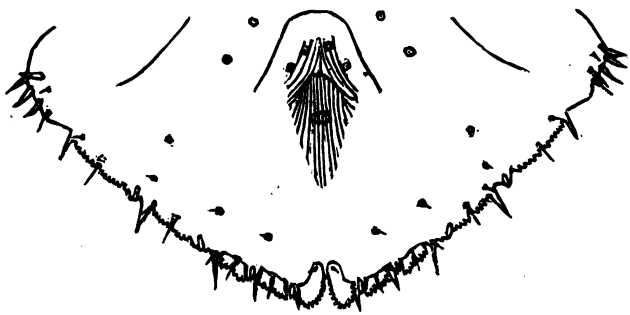

FIG. 13 (Fig. 105, Cornell series)

The groups of *spinnerets* are wanting. In two specimens, however, I have seen a single compound spinneret in place of the mesal and cephalo-lateral groups. A number of simple spinnerets are located as shown in the figure. Upon the disk of each of those near the margin of the segment was observed a delicate short spine.

The mesal *lobes* are conspicuous, diverge distad, and are serrate. They are larger and more distinctly serrate than in *Ch. euonymi.* The second and third lobes are deeply incised, and more or less serrate. In each case the mesal lobule is larger than the lateral one.

There is one *plate* laterad of each lobe, one midway between third lobe and the penultimate segment, and one near the penultimate segment. This segment and the antepenult bear on each side five or six plate-like spinnerets.

On the dorsal surface, the *spines* are as follows: One laterad first lobe; one between the lobules of the second and third lobes respectively; one a little more than halfway from the third to the fourth plate; and one similarly situated between the fourth and fifth plates. There is usually a notch or incision in the margin of the segment near which the fourth and fifth spines are situated. On the ventral surface, the first spine is obsolete or wanting; the second and third are laterad of the lateral lobule of the second and third lobes respectively; the fourth and fifth are just mesad of the base of the fourth and fifth plates respectively. There are also one or two spines among the plates on the penultimate and antepenultimate segments.

This species may readily be distinguished from *Ch. euonymi* by the following characters: there are no groups of spinnerets; the mesal lobes are larger and more distinctly serrate than in *Ch. euonymi*; and in the last-named species the plates are in twos, while in *Ch. citri* they occur singly.

THE CHIONASPIS OF EUONYMUS

76. Chionaspis euonymi Comstock.

This is a very destructive enemy of *Euonymus latifolia* at Norfolk, Va. For description and figures, see Agr. Report 1880, page 313. I know of no other food plant of this species than euonymus, the supposed specimens of this species on orange having proved specifically distinct. (See *Chionaspis citri*, above.)

THE SCURFY BARK LOUSE

77. Chionaspis furfurus (Fitch).

"Approaches *Coccus cryptogamus* Dalman." Harris, Insects injurious to vegetation, 1841, p. 203 (Flint ed., p. 254).
Aspidiotus furfurus Fitch, Report N. Y. State Agr. Soc., 1856, p. 352.
Aspidiotus cerasi Fitch, Report N. Y. State Agr. Soc., 1856, p. 368.
Coccus Harrisii Walsh, Prairie Farmer, May 1860.
Aspidiotus Harrisii Walsh. Signoret, Essai, 1876, p. 604.
Chionaspis furfurus (Fitch) Comstock, Report 1880, p. 315.

This is the common white scale of pear and apple. It also infests the different species of cherry, and has been found on the European mountain ash (*Sorbus aucuparia*) in this country. For description and figures, see Agr. Report 1880, page 315.

LINTNER'S SCALE INSECT

78. Chionaspis lintneri n. sp. (Fig. 14).

I have received from the State Entomologist of New York a species of Chionaspis which infests a species of alder, *Viburnum lantanoides,* and a third unknown plant.

Scales.— The scales of this species so closely resemble those of *Chionaspis salicis* that I have been unable to detect any constant difference. That of the female is white, sometimes slightly brownish, much widened near the caudal end, and with the exuviae naked; that of the male is white and tricarinated.

Female.— The color of the body in old dry specimens is reddish brown with the last segment yellow. In living specimens it is probably as with *C. salicis,* reddish.

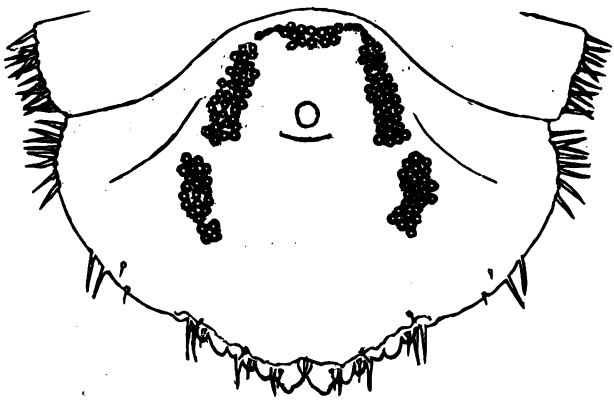

FIG. 14 (Fig. 106, Cornell series)

There are five *groups of spinnerets* (Fig. 14): the mesal consists of eleven to seventeen, the cephalo-laterals each of thirty to forty, usually thirty-five, and the caudo-laterals of about twenty-five. The mesal and cephalo-lateral groups are confluent, being joined by two or three rather elongated spinnerets.

There are three pairs of well-developed *lobes*; the distal ends of the mesal lobes are pointed or obscurely trilobed; the second and third lobes are deeply incised; the mesal lobule is in each case much the larger; the distal margin of each lobule is simply rounded.

There is one *plate* laterad of each of the mesal and second lobes; usually two laterad of each third lobe, but sometimes only one; and two plates about halfway between each third lobe and the penultimate segment. The penultimate segment bears on each side six to nine plates, and the antepenultimate about twelve; there are also a few of these plates cephalad of this segment.

On the dorsal surface there is a *spine* on the lateral part of each lobe, and one a short distance mesad of the fifth plate. The ventral spines are much smaller, and in each case with the exception of the first, which is wanting, are situated a short distance laterad of those on the dorsal surface.

THE SOUR-GUM SCALE

79. Chionaspis nyssae Comstock.

This is a species found upon the black, or sour, gum (*Nyssa multiflora*), in North Carolina. For description and figure, see Agr. Report 1880, page 316.

THE CALIFORNIA WILLOW SCALE

80. Chionaspis ortholobis Comstock.

I found this species upon willow in southern California. It differs from all other known species of this genus in that the scale of the male is not carinated. For description and figures, see Agr. Report 1880, page 317.

THE PINE-LEAF SCALE INSECT

81. Chionaspis pinifolii (Fitch).

Aspidiotus pinifoliae Fitch, Report N. Y. State Agr. Soc., 1855, p. 488.
Mytilaspis pinifolii (Fitch) LeBaron, First Report State Entomologist of Illinois, p. 83.
Chionaspis pinifoliae (Fitch) Comstock, Report 1880, p. 318.

This is the common white scale of pine and spruce; it occurs throughout the United States. For description and figures, see Agr. Report 1880, page 318.

The color of the eggs of this species is purplish brown, covered slightly with a whitish powder.

Natural enemies.— This species is preyed upon by the chalcid parasite *Aphelinus mytilaspidis* LeBaron, which is described in Agr. Report 1880, p. 354.

THE CHIONASPIS OF OAK

82. Chionaspis quercus Comstock.

This is an interesting species which I found on white oak (*Quercus lobata*), in the San Fernando Valley, California. It differs from all Diaspinae known to me in that the caudal end of the body of

the female is terminated by a single mesal lobe. For description and figures, see Agr. Report 1880, page 319. Add to this description Plate XI, figure 8, scale of female.

THE WILLOW SCALE

83. Chionaspis salicis (Linn.).

Coccus salicis Linn., Syst. Nat., 741, 15.
Chionaspis salicis Signoret, Essai, 1869, p. 447.
Chionaspis fraxini Signoret, Essai, 1869, p. 445.
Aspidiotus salicis-nigrae Walsh, Report Acting State Entomologist of Illinois (1868), p. 40.
Mytilaspis salicis LeBaron, Second Report State Entomologist of Illinois (1872), p. 140.

This is the common white scale of willow and ash in Europe and in this country. For description and figures, see Agr. Report 1880, page 320; Plate XVI, figure 5, margin of last segment of female. Compare this figure with figure 6 of the same plate, which represents the margin of the last segment of *Ch. ortholobis*. The important character is the *direction* of the mesal lobes. The number of the plates on the lateral margin of the segment varies in each species. The most conspicuous difference between these two species is presented by the scale of the male, which is tricarinated in *Ch. salicis* and has no carinae in *Ch. ortholobis*.

THE SALT-MARSH-GRASS SCALE

84. Chionaspis spartinae n. sp. (Plate III, figs. 3 and 3*a*).

This species is especially interesting on account of its habitat. It was collected by Mr. William Trelease on salt marsh grass (*Spartina stricta*), at Woods Holl, Mass. The insects were on plants growing so that at high tide they were commonly submerged in pure salt water nearly up to the insects, which when collected were drenched with salt spray. The insects occurred in great numbers on the pieces of grass which I received, the inner surface of the leaves being completely covered so that the scales overlapped. None were observed on the outer surface of the leaves. All the scales were so situated that the cephalic end was uppermost.

Scale of female.— The scale of the female is snowy white, with the exuviae bright yellow. The second skin, however, is more or less covered with the white excretion. The scales are long, narrow, and curved, resembling those of Mytilaspis in form, but differing from that genus in color.

Female.— The color of the full-grown female before oviposition is as follows: head and cephalic part of second segment lemon-yellow; caudal part of second segment, third, and fourth segments purplish red; fifth, sixth, and seventh segments lemon-yellow with central line of purple; last segment light orange-yellow. The purplish red of the body was due apparently to the color of the contained eggs. The last segment presents the following characters (Plate III, figs. 3 and 3*a*):

The mesal group of *spinnerets* consists of fifteen to twenty, the cephalo-laterals of thirty to forty, the caudo-laterals of twenty-five to thirty.

The mesal *lobes* are small, acutely triangular, and diverging; the second lobes are inconspicuous and incised; the third lobes are rudimentary.

There are two *plates* laterad of each lobe, and two near the penultimate segment. The mesal member of each pair of plates is the smaller, and is sometimes concealed by the lateral plate; so that there appears to be but one where there are two.

On the ventral surface there is a *spine* near the base of each group of plates; on the dorsal surface there is a spine a short distance mesad of each of the ventral spines, spines one, two, and three being on the corresponding lobes. On the ventral surface there is a second row of spines a short distance from the caudal margin of the segment (Fig. —).

Scale of male.— The scale of the male is snowy white, with the larval skin bright yellow; it is tricarinate or unicarinate, the lateral carinae being feeble or wanting.

SPECIES OF CHIONASPIS NOT YET OBSERVED IN THE UNITED STATES

85. Chionaspis aceris Signoret.

Chionaspis aceris Signoret, Essai, 1869, p. 442.

A species of Chionaspis which infests maple in Europe is de-

scribed by Signoret under the name of *C. aceris*. The scale of the female resembles that of *C. salicis*. The scale of the male presents a feeble carina on the middle line; the extremity is rounded and flat. The last segment of the female presents a single pair of lobes, and on each side five or six plates. The penultimate segment bears six or seven plates on each side, and the antepenult three. The cephalic border of the head, which is slightly concave, presents two little hairs, and, near the border, two little irregular protuberances which Signoret believed to be vestiges of antennae.

86. Chionaspis alni Signoret.

Chionaspis alni Signoret, Essai, 1869, p. 443.

This is a species collected by Signoret on the bark of alder in Switzerland. The scale of the female is of the typical form, white, with the exuviae reddish brown. The female is long with the abdominal segmentation very pronounced, the color is yellow a little reddish; the mesal group of spinnerets consists of twelve to fifteen, the cephalo-laterals of seventeen to eighteen, and the caudo-laterals of fifteen to sixteen. The scale of the male resembles that of *Ch. salicis*.

87. Chionaspis aspidistrae Signoret.

Chionaspis aspidistrae Signoret, Essai, 1869, p. 443.

This is a species which infests a Chinese liliaceous plant belonging to the genus Aspidistra, a plant used as an ornamental house plant. The scale of the female forms a thin pellicle; it is of the typical form, but is remarkable on account of the large size of the second skin, which with the first occupies about one-third of the length of the scale. The female as described by Signoret is also quite remarkable. The body is yellow, much elongated, with the abdominal segmentation very distinct, the segments being prolonged laterally into prominent lobes; the last segment bears a single pair of lobes, which are trilobed (*trifolies*); the mesal group of spinnerets of eight to nine, the cephalo-laterals of eighteen to twenty-four, and the caudo-laterals of fifteen to eighteen. The lateral groups of spinnerets are sometimes nearly continuous. The scale of the male is tricarinated; the larval skin occupies hardly

one-fifth of the length of the scale, which is four times longer than wide. The male is grayish white, more or less rosy, the color is a little deeper on the head and the middle of the prothorax. The mesothorax is very long so that the first pair of legs are widely separated from the second. The wings are long.

88. Chionaspis braziliensis Signoret.

Chionaspis braziliensis Signoret, Essai, 1869, p. 444.

This species was described from specimens collected at Bahia, Brazil. The food plant is a shrub the name of which is not given. The scale of the female is yellowish white with the exuviae brownish yellow. The mesal lobes of the last segment of the female are hardly visible; the mesal group of spinnerets consists of eight, the cephalo-laterals of fourteen to fifteen, and the caudo-laterals of fifteen to sixteen. The scale of the male is white and carinated.

89. Chionaspis planchonii Signoret.

Chionaspis planchonii Signoret, Essai, 1869, p. 446.

This species infests oak (*Quercus ilex*) in southern Europe. The scale of the female is white with the exuviae clear yellow. The body of the female is yellow; the mesal group of pores consists of fifteen, the cephalo-laterals of at least thirty-five, and the caudo-laterals of fifteen. The mesal and cephalo-lateral groups are nearly continuous. The scale of the male resembles that of *Ch. salicis*, but it is twice as large. The branches upon which the female scales exist present a very light excretion resembling mould. A similar character is presented by *Ch. populi* and *Diaspis boisduvalii*. The last-named species is the only one of the three which I have met, and in that this excretion is produced by the males.

90. Chionaspis populi (Bärensp.).

Aspidiotus populi Bärensprung. Zeit. für Zool., Zoot., Alton et Burm (1849), 167.
Chionaspis populi Signoret, Essai, 1869, p. 446.

The species of Chionaspis which infests poplar in Europe has been named *Ch. populi*, but the descriptions of the species are very imperfect. The species is said to be closely allied to *Ch. salicis*, but to differ from that species as follows: in *Ch. populi* the male is yellow, and the scales are accompanied by an excretion

resembling mould; in *Ch. salicis* the male is red, and the mould-like excretion is absent.

91. Chionaspis vaccinii (Bouché).

Aspidiotus vaccinii Bouché, Ent. Zeit. Stett., XII, 111.
Diaspis niveus Bremi. Coll., Mayr (Signoret).
Chionaspis vaccinii Signoret, Essai, 1869, p. 448.

This is a species which infests a species of cranberry (*Vaccinium myrtillus*) in the forests of Switzerland. It is said to resemble *Ch. salicis*. The scale is white with the exuviae brownish red. The female is long, narrow towards the head, and widest at the penultimate segment. The mesal group of pores consists of fifteen to seventeen, the cephalo-laterals of eighteen to twenty, and the caudo-laterals of twenty to twenty-five. The mesal lobes are well developed, and on each side there are two smaller lobes. The scale of the male is long, carinated, and snowy white.

Genus **UHLERIA** Comstock

This genus includes species of Diaspinae in which upon the scale of the female only one larval skin is visible at the cephalic extremity; the second skin is present, but it is entirely covered by secretion. This skin is large, covering the insect entirely. The scale is narrow at its cephalic end; it soon widens, and the sides are parallel throughout the greater part of its length. The three cephalic groups of spinnerets are united, forming a continuous line.

This is the genus Fiorinia of Targioni-Tozzetti. It was established by that author to receive the species described by him under the name *Diaspis fioriniae*. This author at the same time changed the specific name of the species to *pellucida*. According to the rules of nomenclature now generally adopted by zoologists, the original specific name must be restored and a new generic name given.

It gives me great pleasure to name this genus in honor of our highest authority on the order of insects to which it belongs. And I wish here to acknowledge the encouragement and material aid in my studies of the Coccidae which he has so generously given me.

THE UHLERIA OF CAMELLIA

92. Uhleria camelliae Comstock (Plate II, fig. 9).

Fiorinia camelliae Comstock, Agr. Report 1880, 329.

This is a very troublesome pest of the camellia in the conservatories of the U. S. Department of Agriculture. It also infests a palm (*Kentia balmoriana*) and *Cycas revoluta.* For description and figures, see (under name of *Fiorinia camelliae*) Agr. Report 1880, page 329.

SPECIES OF UHLERIA NOT YET OBSERVED IN THE UNITED STATES

93. Uhleria fioriniae (Targ.-Tozz.).

Diaspis fioriniae Targ.-Tozz. (1867), Studi sulle Coccinigliе, 14.
Fiorinia pellucida Targ.-Tozz., Catal. (1868), 42.
Chermes arecae Boisduval, Insect. Agric. (1868).

This species is said to be common on many plants in hothouses in Europe, and especially upon *Areca aurea* and *Phytelephas macrocarpa.* As yet I have not met this species but I presume it will be found in this country on hothouse plants.

According to Signoret (Essai, 1869, 449), this species is characterized as follows: The scale of the female is thin, of a transparent brownish yellow with the base a little darker. The sides are almost parallel. There is but little secretion outside of the second skin of which the scale is formed. The female is grayish yellow, three times longer than wide, and bears on the lateral margin of each segment a spine and on the penultimate segment two or three. The last segment bears a curved line of spinnerets, fifteen in number according to the plate, and two groups, the caudolaterals, of five to six each. The scale of the male is of the same nature and form as that of the female, only it is smaller and narrower.

94. Uhleria gigas (Maskell).

Diaspis gigas Maskell, Trans. and Proc. New Zealand Institute, XI, 201.
Fiorinia asteliae Maskell, l. c., XII, 292.

This is a New Zeland species which infests *Atherosperma novaezealandiae.* The scale of the female is sometimes more than one-

eighth inch long and one-sixteenth inch wide. The female is one-twelfth inch in length. The scale is yellowish brown or dirty white, flat, roughly pear-shaped, thin in texture. The first skin occupies the broad end, the second nearly the entire scale. According to Maskell's figure there are about sixty spinnerets arranged in an arc cephalad of the vaginal opening.

Genus **PARLATORIA** Targioni-Tozzetti

Scale of the female either circular or elongated, with the exuviae at the cephalic margin or end. Scale of male elongated, with the sides nearly parallel, and the exuviae at the cephalic end. The mesal part of the scale of the male is not carinated and is seldom higher than the sides; usually, and especially with old scales after the adult has emerged, the mesal part is depressed, giving that part of the scale caudad of the larval skin the form of a gutter.

The margin of the last segment of the female is crenulated, and fringed with toothed scale-like plates. (See Agr. Report 1880, Pl. XIX, fig. 3, and Plate XX, fig. 5, also Plate IV of this report.)

In this genus the form of the scale of the female varies greatly. (See Plate II, figs. 6, 7, and 8.) The only generic character presented by the scale of this sex is the large size of the second skin. The form of the scale of the male is, however, quite constant. But the most important generic character is the structure of the margin of the last segment of the female.

There is but little variation in the structure of the margin of this segment in the three or four species of Parlatoria which are known (see Plate IV). There are only four groups of spinnerets, each usually consisting of eight or nine; but the number in each group varies from four to ten. There are three pairs of well-developed lobes; each lobe is widest near the middle, tapering cephalad, and suddenly narrowed caudad. Except in *P. proteus* (Plate IV, fig. 3), there is a fourth rudimentary lobe upon each side about midway between the third lobe and the penultimate segment; this is represented at *a* in the figures of Plate IV. In *P. pergandii* (Plate IV, fig. 2), and var. *camelliae* (Plate IV, fig. 4), there is a similar lobe on the penultimate segment, cephalad of the caudal plate of

that segment. Connecting the bases of the lobes in all the species are crescent-shaped thickenings of the body wall, which are in reality the thickened margins of elongated pores placed at right angles to the median line of the body. In each species there are two plates between the mesal lobes; two between first and second lobes; and three between second and third lobes. These are similar in shape, and in each case extend caudad as far as the tips of the lobes. Each plate is oblong, with the sides parallel and with the distal extremity fringed. Between the third and fourth lobes are three plates varying in shape from the form just described to palmate. The plates on this segment cephalad of the fourth lobe are usually palmate. The three segments preceding the last bear from five to ten plates each, on each lateral margin. The shapes of these plates afford specific characters. Each lobe bears a spine on its dorsal surface near the lateral margin at its base. The spines of the ventral surface (except the first, which is obsolete), are longer and more conspicuous; the second, third, and fourth are each situated cephalad of the lateral margin of the first plate laterad of the second, third, and fourth lobes respectively. Each of the three segments preceding the last bears a conspicuous spine near the middle of each lateral margin.

The species can be readily distinguished as follows:

A. Scale of female circular. **pergandii.**

AA. Scale of female elongated.

B. Scale black. **zizyphi.**

BB. Scale brownish yellow. **proteus.**

95. Parlatoria pergandii Comstock (Plate II, figs. 6 and 6*a*; Plate IV, fig. 2).

Parlatoria pergandii Comstock, Agr. Report 1880, p. 327.

This species infests the trunk, leaves, and fruit of citrus trees in Florida. See Agr. Report 1880, page 327; Plate XI, fig. 4*a*, scale of female, 4*b*, scale of male; Plate XXI, fig. 8, male; Plate XIX, fig. 3, last segment of female; Plate XX, fig. 5, margin of the same.

Natural enemies.— I have bred from this species the parasitic chalcis fly *Aphelinus fuscipennis* Howard, which is described in my report for 1880, page 356.

Parlatoria pergandii *var.* **camelliae** (Plate IV, fig. 4).

Upon the leaves of camellia growing in the conservatory of the Department of Agriculture were found a few specimens of a species of Parlatoria which is either *P. pergandii* or a distinct species very closely allied to it. I am inclined to the latter view, but am unwilling to decide until I have seen more specimens. The form on camellia differs from that on orange as follows: The scale of the female widens suddenly near the middle of the second skin; thus one-half of the exuviae project beyond the part of the scale composed of excretion. In *P. pergandii,* although the exuviae are marginal, they rarely project beyond the margin. The fourth and fifth lobes of the margin of the last segment of the female (Plate IV, fig. 4, *a* and *b*) taper to a point. In *P. pergandii* they are more or less rounded and each is terminated by a papilla. In var. *camelliae* the plates laterad of the fifth lobe are fringed more than the corresponding plates in *P. pergandii.* Described from three females.

96. Parlatoria proteus (Curtis) (Plate II, figs. 7 and 7*a*; Plate IV, fig. 3).

Aspidiotus proteus Ruricola (Curtis). Gardeners' Chronicle, 1843, p. 676.
Parlatoria orbicularis Targ.-Tozz., Catal. (1868), 42.
Parlatoria proteus Curtis. Signoret, Essai, 1869, p. 450.

This is a species which as yet I have found only in a single locality in this country, and in small numbers. It infests the leaves of a species of Microsamia growing in the conservatory of the Department of Agriculture. Although careful search was made, we were unable to detect its presence on any other plant. It probably occurs, however, in other conservatories in the United States, and upon other plants, as it is well known in Europe, where it infests several species of plants but especially Selenipedium and Vanda. Through the kindness of M. Signoret I have received specimens from Europe, and have thus been able to prove the specific identity of our species.

The scale of the female (Plate II, fig. 7) is elongate, more or less oval, of a transparent brownish yellow color, and whitish toward the border. The exuviae are rounded oval in form; in

length they are equal to about three-sevenths of the length of the fully formed scale.

For a description of the last segment of the female see the generic characters given above. This species is peculiar in wanting the fourth lobe; in place of this lobe there is a small fringed plate (Plate IV, fig. 3*a*). The plates on the three segments preceding the last are more irregular in form than in other species of this genus (Plate IV, fig. 3).

The scale of the male (Plate II, fig. 7*a*) is light brown with the exuviae black.

97. Parlatoria zizyphi (Lucas) (Plate II, fig. 8; Plate IV, fig. 1).

Coccus ziziphus Lucas (1853), Ann. Soc. Ent. Fr., Bull. XXVIII.
Kermes aurantii Bolsd. (1867), Ent. Hort., 338.
Parlatoria Lucasii Targ.-Tozz., Catal. (1868), 42.
Parlatoria zizyphi (Lucas) Signoret, Essai, 1869, p. 451.

This is a species which infests oranges in Europe and is occasionally found on imported oranges in our markets. It is readily recognized by the form and color of the scale of the female (Plate II, fig. 8).

The scale of the female is long and very black. This color is due to the color of the exuviae which are so large that they cover nearly the whole scale as shown in the figure. The first skin is oval and of medium size; the second skin is quadrangular, elongate, and very large. On the middle line there is usually a longitudinal depression in the center of which there is a ridge. That part of the scale which extends beyond the caudal end of the second skin is brownish white.

The fourth lobe of the last segment of the female is as long as the other lobes and tapers evenly to a point. The plates on the margins of the three segments preceding the last are as long as any of the lobes, are crowded together, and are irregularly incised (Plate IV, fig. 1).

The scale of the male is of the form characteristic of the genus. It is dirty white with the larval skin black.

Genus **MYTILASPIS** Targ.-Tozz.

This genus includes the species of Diaspinae in which the scale is long, narrow, more or less curved, and with the exuviae at the cephalic extremity. The scale of the male resembles that of the female in form, but it can be readily distinguished by its small size and by bearing only one larval skin.

In all the species of Mytilaspis which I have studied the caudal part (about one-fourth) of the scale of the male is joined to the remainder by a thin portion which serves as a hinge, allowing the posterior part to be lifted when the male emerges.

There is little danger of species of Mytilaspis being placed in any other genus; but members of other genera are liable to be mistaken for Mytilaspis. See Chionaspis, Fiorinia, and Parlatoria.

I believe that the recognizing of different species of the Coccidae has been in many cases more a matter of feeling than of knowledge; and this has been the case especially in the genus Mytilaspis. There is no doubt that new names have been given to forms simply because they looked a little different from other forms, or because they occurred on a different plant. To my mind it is evident that the characters by which the closely allied species of this genus can be distinguished have not been worked out. And until they are determined I cannot see what is to be gained by giving a name to every form which seems to be a little different from other forms, or which infests a plant different from those infested by the other forms.

According to the plan adopted by a large proportion of the writers who have described Coccidae, I have before me nearly forty American "species" of the genus Mytilaspis. But excepting *M. pandani,* which is placed in this genus only provisionally, I am able to distinguish but three American species. And it is even quite difficult to state definitely the differences between two of these. The following statement will serve the purposes of an analytical table:

M. pandani may be recognized at once by the large size of the exuviae.

M. gloverii differs from the other American forms by its very narrow scale within which the eggs are deposited in two regular rows.

There remain of the recognized American species only *M. citricola* and *M. pomorum*. The former has been found only on citrus plants; the latter, although it infests very many plants, has not been found on any belonging to the genus Citrus. This, however, is not given as a character, but simply an interesting fact. The mesal group of spinnerets are almost invariably arranged in a single row in *M. citricola*; in *M. pomorum* they are massed, and are greater in number. The mesal lobes in *M. citricola* are only two-thirds as wide as in *M. pomorum*. The distal end of each mesal lobe in *M. citricola* bears many notches; in *M. pomorum* it is nearly entire.

THE ORANGE SCALE

98. Mytilaspis citricola (Packard).

Aspidiotus citricola Packard, Guide to the study of insects, second edition, (1870), 527.
Mytilaspis citricola (Packard), Comstock, U. S. Agr. Report 1880, 321.

This is one of the two most common species of scale insects found on citrus trees in Florida. It is probably an European species, as I have frequently found it on imported oranges in our market. It also occurs in Louisiana. For description and figures, see Agr. Report 1880, page 321. Compare with *M. gloverii*.

From this species I have bred the chalcid parasite *Aphycus flavus* Howard, described in Agr. Report 1880, page 365.

GLOVER'S SCALE

99. Mytilaspis gloverii (Packard).

Coccus gloverii Packard, Guide to the study of insects (1869), p. 527.
Aspidiotus gloverii Packard, ibid., second edition (1870), p. 527.
Mytilaspis gloverii (Packard). Ashmead, Orange insects, 1880, p. 1.

This is a very common species on citrus trees in Florida and Louisiana. It infests the fruit, leaves, and bark of the trees, and is usually associated with *M. citricola*. For description and figures, see Agr. Report 1880, page 323. Compare with *M. citricola*.

THE PANDANNIS SCALE

100. Mytilaspis pandani Comstock.

This species, which I have referred provisionally to Mytilaspis, occurs upon pandanus in the Harvard Botanic Garden at Cambridge, Mass. For description and figures, see Agr. Report 1880, page 324.

THE OYSTER-SHELL BARK LOUSE OF THE APPLE

101. Mytilaspis pomorum (Bouché) (Plate II, figs. 5 and 5*a*).

Aspidiotus pomorum Bouché, Ent. Zeit. Stett. (1851), XII, no. 1.

Aspidiotus conchiformis of authors; but not *A. conchiformis* Gmelin, Syst. Nat., 2221.

Aspidiotus pyrus-malus Bob. Kennicott (1854), Acad. Science of Cleveland.

Aspidiotus juglandis Fitch, Annual Report N. Y. State Agr. Soc., 1856, 163. (Not the species described under this name by Signoret, Essai, 1870, 95.)

Mytilaspis pomicorticis Riley, Fifth Report State Entomologist, Missouri, p. 95.

Mytilaspis pomorum (Bouché). Signoret, Essai, 1870, p. 98.

This is the most widely spread and best-known scale insect infesting apple. In certain parts of California its ravages are overshadowed by the greater injuries of the pernicious scale insect (*Aspidiotus perniciosus*), but even there the oyster-shell bark louse of the apple is a formidable and well-known pest.

For description, list of food plants, and figure, see Agr. Report 1880, page 325.

From this species I have bred the following-named chalcid parasites, all of which are described in the report just cited: *Aphelinus mytilaspidis* LeBaron, *Aphelinus abnormus* Howard, *Aphelinus fuscipennis* Howard, and *Anaphes gracilis* Howard.

It is very unfortunate that the oyster-shell bark louse of the apple has been known at different intervals by widely different names. This is especially to be regretted as the species is one that interests a very large number of people who cannot be expected to keep track of the changes in scientific nomenclature. But without a knowledge of these changes it is impossible for one to avail himself of what has been published in the various books and

agricultural journals on this subject; for the reader will be sure to think that the different articles are concerning very different insects. I will therefore give a brief sketch of the changes which have occurred.

In 1738 Reaumur* first called attention to the group of insects to which the oyster-shell bark louse of the apple belongs. On plate five of the fourth of his Memoires he figures a bark louse upon elm which is undoubtedly a Mytilaspis; and he proposes for this genus, which was then described for the first time, the name *Coccids in the form of a shell (Des gallinsectes en forme de coquille).*

In 1762 the species of Mytilaspis which infests elm was named *Coccus arborum linearis* by Etienne Louis Geoffroy.†

In 1788 this species was named *Coccus conchiformis* by Gmelin in his edition (ed. XIII) of the Systema Naturae of Linnaeus. *Conchiformis* being the first specific name proposed for this species in accordance with the rules of nomenclature now in use, is the one adopted for it.

In 1833 Bouché‡ established the genus Aspidiotus for those species of Coccidae which live under a scale. Accordingly the scientific name of the oyster-shell bark louse of the elm, as we may call it, became *Aspidiotus conchiformis.*

In 1843 Curtis, writing over the pseudonym of *Ruricola* in the Gardeners' Chronicle (pages 735–736), gave a description and figures of "the apple-tree mussel scale," or "dry scale." This is doubtless the same insect as that which is known in this country as the oyster-shell bark louse of the apple. Curtis considered this insect as identical with that which infests the elm and which has been described by Gmelin under the specific name of *conchiformis.* He therefore applied the name *Aspidiotus conchiformis* to this pest of the apple.

Twelve years later Dr. Fitch,§ the first State Entomologist of New York, gave a description of "the apple bark louse" and, following Curtis, applied the name *Aspidiotus conchiformis* to it, and this name has been applied to this pest of the apple by the

* Memoires pour servir a l'histoire des insectes, Tome IV, 69.
† Histoire abrégée des insectes.
‡ Naturgeschichte der garten insekten, 52.
§ Trans. N. Y. State Agr. Soc., XIII, 735.

majority of writers on economic entomology from the time of Curtis to the present day. It is, therefore, under this name that the student must look for information concerning this pest in most of the standard works on economic entomology.

Unfortunately Curtis and those who followed him overlooked the fact that Bouché had described* the bark louse of the apple as a distinct species from that infesting the elm and had given to it the name of *Aspidiotus pomorum*; by which name it should have been designated by Curtis.

But the progress of science has rendered another change necessary. It is found that the genus Aspidiotus of Bouché includes several genera. Therefore the name Aspidiotus has been restricted to one of these genera, and the name Mytilaspis given to the genus to which the oyster-shell bark louse of the apple belongs. The name, then, of this pest is *Mytilaspis pomorum.*

The matter has been further complicated by the proposal in this country of several other names for what is doubtless this species. These names are given in the table of synonyms above. I will discuss here only one of them, as no writer has persisted in the use of the others.

Professor Riley in his Fifth Missouri Report proposed the name *M. pomicorticis* for this species on the ground that according to the description of Bouché *M. pomorum* has red eggs, while the eggs of this species are white. It is evident, however, that there is a mistake in the description of Bouché; for there is no species of Mytilaspis known in which the eggs are normally red. If no other mistakes of this kind had been made, we might hesitate before pronouncing this to be one; but Bouché in describing *M. pinnaeformis* says that the eggs of this species are also a deep red; while Signoret states that they are white tinged with yellow. Signoret quotes the statement of Bouché as to the color of the eggs and adds, "That depends on the age of the eggs." An American writer† in describing *M. gloverii* states that the eggs are a bright red, notwithstanding that his residence is surrounded with orange trees, upon which may be found at the proper season thou-

* Ent. Zeitung Stett., 1851.
† Ashmead, Orange Insects, p. 4.

sands of scales of this species each covering white eggs. The fact is, as my observations on this particular species (*M. gloverii*) show, the eggs which are white when first laid become tinged with purple before hatching. There can be no reasonable doubt that the species described by Bouché as *M. pomorum* is the common Mytilaspis of the apple of Europe. And as the most careful study has failed to detect any difference between that form and the one which infests apple trees in this country, our species should be known by the same name. The suggestion made by Mr. Riley* that, in case Bouché's description does refer to our species, it "is so false in one of the most important characters that it is valueless and should be ignored," cannot be seriously entertained. Nothing could quicker bring confusion into our nomenclature than the adoption of the doctrine that a misstatement in a specific description should render the description void.

SPECIES OF MYTILASPIS NOT YET OBSERVED IN THE UNITED STATES

102. Mytilaspis abietis (Schrank).

Coccus abietis Sch., Beit. zur Naturg. (1776), 48.
C. arborum Sch., Enum. Ins. Aust. (1781), 295.
C. pineti Sch., Fauna Boica (1801), 146.
Mytilaspis abietis (Sch.) Signoret, Essai, 1870, 92.

This species infests the branches of fir or spruce (Abies) in Europe. Scale of female long, straight or more or less curved and grayish brown in color. Female of a grayish brown, broad towards the caudal end and narrow towards the head. Five groups of spinnerets: the mesal consist of fifteen to seventeen, the cephalo-laterals each of twenty, and the caudo-laterals of ten to twelve.

103. Mytilaspis (?) buxi (Bouché).

Aspidiotus buxi Bouché, Ent. Zeit. Stett., XII, 110.
Mytilaspis? buxi (Bouché) Signoret, Essai, 1870, 93.

This species is found on the leaves of box (*Buxus sempervirens*)

*American Naturalist, 1874, 168.

in Europe. It is remarkable for the large size of the exuviae, the second skin reaching the middle of the scale; the form of the scale is an elongated oval. The last segment of the female bears five groups of spinnerets: the mesal consists of eight to nine, the cephalo-laterals each fourteen to fifteen, and the caudo-laterals of ten to eleven. There are two pairs of lobes; the mesal lobes are each trilobed. Scale of male small, deep yellow, and with the sides parallel. Male elongated, yellow with the thoracic band brown.

104. Mytilaspis conchiformis (Gmelin).

Ch. conchiformis Gmelin (1788), Syst. Nat., 2221.
Asp. conchiformis Curtis, Gard. Chron. (1843), 735.
Diaspis linearis Costa, Faun. Regn. Nap. (1837) Gall. Ins. 21, 3.
Mytilaspis linearis Targ.-Tozz., Catal. (1869), 45, 1.
Mytilaspis conchiformis (Gmelin) Signoret, Essai, 1870, 93.

This is the species found on elm in Europe. The scale resembles that of *M. pomorum*. The female has five groups of spinnerets. The mesal group consists of six to seven, the cephalo-laterals each of eight to nine, the caudo-laterals of five to six.

105. Mytilaspis cordylinidis Maskell.

Mytilaspis cordylnidis Maskell, Trans. and Proc. New Zealand Institute, XI, 195.

This is a New Zealand species which infests a large number of plants in that country, of which the following are enumerated by Maskell: Cordyline, Asplenium, Phormium, Gahnia, Drimys, Astelia, and Eucalyptus.

The scale is very long and narrow, generally straight, sometimes curved, semi-cylindrical. Length about one-eighth inch; breadth one-thirtieth inch. Color pure white except the exuviae, which are bright yellow. The exuviae occupy rather more than one-fourth the length of the scale. The eggs are of a bright yellow color. The adult female is pale golden, about three times as long as broad. There are five groups of spinnerets. The mesal group consists of seven to eight, the cephalo-laterals of fourteen to twenty, the caudo-laterals of twenty to twenty-five.

106. Mytilaspis drimydis Maskell.

Mytilaspis drimydis Maskell, Trans. and Proc. New Zealand Ins., XI, 196.

This is a New Zealand species which infests *Drimys colorata.* The scale is straight, long, and narrow. Average length one-twelfth inch; breadth one-thirtieth inch. Color generally a dirty white, sometimes brown, yellow at the end with the exuviae, which are oval, narrowing somewhat at the tip. The adult female is of a dull red color. The head and thoracic portion of the body are smooth and round. The remainder of the body, on the corrugations, has a row of short, thick, tubular bristles, extending down the edge as far as the commencement of the last segment. There are no groups of spinnerets. Two pairs of lobes well developed.

107. Mytilaspis ficus Signoret.

Mytilaspis flava Targ.-Tozz., Catal. (1868), 44.

This species infests fig in Europe. The scale of the female resembles much that of *M. linearis,* only it is more elongated, and often more curved. The last segment of the female bears five groups of spinnerets. The number of those in the mesal group was not determined; the cephalo-laterals consist each of eight to nine, and the caudo-laterals of six to seven.

108. Mytilaspis flava Targ.-Tozz.

Mytilaspis flava Targ.-Tozz., Catal. (1868), 44.

This species infests olive in Europe. The scale of the female resembles that of *M. linearis,* only it is narrower and covered with a grayish powder. The female is also similar to *M. linearis,* but generally has the segments more pronounced. The last segment bears five groups of spinnerets. The mesal group consists of three, the cephalo-laterals each of six to eight, and the caudo-laterals each of six to seven. The mesal lobes are well developed. The scale of the male is clearer, being almost yellow.

109. Mytilaspis flavescens Targ.-Tozz.

Mytilaspis flavescens Targ.-Tozz., Ann. del Minist. Agric., Ind. e Commerc., 1876, 36.

This species infests oranges and lemons in Europe. The scale resembles that of *Mytilaspis gloverii* which I have described and

figured already. According to Signoret (Essai, 1876, 604), the last segment of the female resembles much that of *Leucaspis pini*, but it bears only a few compound spinnerets. These are arranged in a crown, a group of four or five ending on each side the median curve, which is composed of only one or two.

110. Mytilaspis juglandis Signoret (not of Fitch).

Mytilaspis juglandis Asa Fitch. Signoret, Essai, 1870, 95.

This species infests butternut in Europe. It was supposed by Signoret to be the same as that described by Dr. Fitch under the name of *Aspidiotus juglandis*. But I have carefully examined a specimen of *A. juglandis*, which is probably the type of Dr. Fitch's species, being the one in the collection of the N. Y. State Agr. Society and labeled in his handwriting, and find that it is the same as the species which occurs on apple, and which is known as *M. pomorum*. Therefore the name proposed by Dr. Fitch must be considered a synonym of *M. pomorum*. I have, however, retained the name *juglandis* for the European form occurring on butternut, and cite Signoret's description as the original description of the species. The most important character given by Signoret is the number of spinnerets. There are five groups: the mesal consists of only two, the cephalo-laterals each of six, and the caudo-laterals of five. It is evident from the text that but one specimen was studied.

111. Mytilaspis linearis of authors.

Mytilaspis linearis (Geoffroy) Signoret, Essai, 1870, 96.

This species infests linden in Europe. The scale of the female resembles that of *M. pomorum*. The last segment bears five groups of spinnerets which are almost continuous. The mesal group consists of six to seven, the cephalo-laterals each of ten to twelve, and the caudo-laterals of nine to ten.

112. Mytilaspis metrosideri Maskell.

Mytilaspis metrosideri Maskell, Trans. and Proc. New Zealand Institute, XII, 293, Plate VII, fig. 2.

This is a New Zealand species which infests the rata tree (Metrosideros). The scale is white, pyriform. Female in all

stages dark-colored; in last stage nearly black. Abdomen of female ends in three minute-pointed lobes joined by a scaly process. Spinnerets in an almost continuous arch, which may be resolved into five groups; the spinnerets number seventy or eighty.

113. **Mytilaspis phymatodidis** Maskell.

Mytilaspis phymatodidis Maskell, Trans. and Proc. New Zealand Institute, XII, 292, Plate VII, fig. 1.

Nothing is given in the description of this species which will separate it from *M. pomorum* except that the scale is broader. The figure represents the lobes as serrate, with long sharp teeth.

114. **Mytilaspis pinnaeformis** (Bouché).

Aspidiotus pinnaeformis (Bouché), Ent. Zeit. Stett. (1851), XII, 110.
Mytilaspis pinnaeformis (Bouché) Signoret, Essai, 1870, 97.

This species infests Cymbidium in Europe. From the description given by Signoret it is evident that the scale resembles that of *M. pomorum* in color and form; the exuviae occupy about one-third of the whole length of the scale. Upon the last segment of the female there are five groups of spinnerets; the mesal consists of four, the cephalo-laterals each of five, and the caudo-laterals each of four. The male is small, yellowish white, with the thoracic band dark.

115. **Mytilaspis pyriformis** Maskell.

Mytilaspis pyriformis Maskell, Trans. and Proc. New Zealand, XI, 194.

This is a New Zealand species, the food plant of which is not given by the describer. The scale is broadly pear-shaped. (Maskell's figure resembles a Chionaspis.) The exuviae occupy the smaller end, and the second skin extends to about the middle of the scale. Color of scale light brown; texture thinner than in *M. pomorum,* and form flatter; length about one-twelfth inch; greatest breadth about one-twentieth inch. The last segment of the female bears an almost continuous arch of spinnerets, which consists of two rows with here and there an outlying one. Altogether there may be from sixty to seventy spinnerets in the arch.

Is this a species of Mytilaspis?

116. Mytilaspis saliceti (Bouché).

Aspidiotus saliceti Bouché, Ent. Zeit. Stett., 1851, 110.
Mytilaspis saliceti (Bouché) Targ.-Tozz., Catal., p. 46.

This name was given to a form found on willow (*Salix holosericea*) in Europe. The female is reddish; the scale pale brown.

Genus **POLIASPIS** Maskell

(Maskell, Trans. and Proc. New Zealand Inst., XII, p. 293)

This genus was established by Maskell to include a species of the Diaspinae in which the scales resemble those of Chionaspis but the female differs in presenting eight groups of compound spinnerets.

Although I am far from feeling sure that the genus will prove to be a natural one, I think it best to describe a species which I have found and which is evidently a congener of that described by Maskell under the same generic name that he applied to his species.

117. Poliaspis cycadis n. sp. (Fig. 15).

This interesting scale insect was found in the conservatory of the Department of Agriculture upon *Cycas revoluta* and *Dion edula,* ornamental plants belonging to the order Cycadaceae. It was also found on a species of Microsamia. It usually occurred on the lower sides of the leaves and was not very abundant.

Scale of female.— The scale of the female is snowy white with the exuviae brownish or yellowish, sometimes nearly transparent. The scale is elongated, as in Chionaspis, and much widened toward the caudal end. The length of the largest scales is 3.2 mm. (.12 inch); their greatest width, 1.6 mm. (.06 inch).

Female.— The color of the female is lemon-yellow with the last segment orange. The full-grown insect is oval, broadest in the region of the second and third segments. The characters presented by the last segment are as follows:

There are eight groups of compound *spinnerets*. The mesal consists of two to four, the cephalo-laterals of eight to thirteen, the caudo-laterals of eighteen to twenty-five, the supra-mesal of two to four, and the supra-cephalo-laterals of two to four.

FIG. 15 (Fig. 107, Cornell series)

The mesal *lobes* are prominent, and distinctly serrate on their distal margin. The second lobe is so deeply incised that each division appears like a lobe of itself. The third lobe is usually obsolete. Of twenty-five specimens examined, in only one was the third pair of lobes present. In this case the third lobe of each side was deeply incised, and, as with the second lobe, the lateral division was the smaller.

The *plates* are slender and cylindrical. There is one laterad of each of the first and second lobes and of the place occupied by the third lobe when present. A fourth lobe is present between the third and the penultimate segment. There are from four to six plates on each lateral margin of each of three or four segments cephalad of the last segment.

There are two *spines* between the mesal lobes. On the dorsal surface on each side there are two spines laterad of the first lobe, one cephalad of the other; one on the lateral division of the second lobe, and one a short distance mesad of each of the third and fourth plates. On the ventral surface on each side there is a spine laterad of the mesal lobe, two cephalad of the lateral division of the second lobe, and one mesad of each of the third and fourth plates.

Egg.— The eggs are white when first deposited, later they change to lemon-yellow, and finally become almost orange-yellow when ready to hatch. The number deposited by each female is about one hundred.

Scale of male.— The scale of the male is snow-white, very small, with sides parallel, and the exuviae at one end. It differs from Chionaspis in wanting carinae. The ventral scale is complete. Some of the male scales are completely hidden by a woolly excretion.

Male.— The body of the male is bright orange-red, with the thoracic band of the same color. The eyes are black. The first five segments of the antennae are purplish red, the other five yellow.

SPECIES OF POLIASPIS NOT YET OBSERVED IN THE UNITED STATES

118. Poliaspis media Maskell.

Poliaspis media Maskell, Trans. and Proc. New Zealand Institute, XII, 293.

The scale is white, broad. The adult female, which may reach one-twenty-fourth inch in length, resembles in outline *Mytilaspis pomorum,* is usually greenish white, and bears rudimentary antennae. There are eight groups of spinnerets: four, consisting each of twenty to thirty, are placed in opposite pairs; the fifth, consisting of four to six, is between the upper pair; above these, three other groups form an arch; the two outer ones consist of eight to ten, and the mesal one of three to five. The male insect is of a bright scarlet or deep orange color.

This is a New Zealand species which infests a Veronica and *Leucopogon fraseri.*

GENERA OF DIASPINAE NOT YET OBSERVED IN THE UNITED STATES

Genus **AONIDIA** Targioni-Tozzetti

(Targioni-Tozzetti, Catal., 1868, p. 43)

Female with two scales superimposed; the first presenting at the center a single molted skin surrounded by secretion; the second, from which the first may be removed after a preliminary macera-

tion in water, composed entirely of the second molted skin. The adult female is smaller than this second scale, and consequently smaller than in the most advanced of its adolescent stages. Scale of the male similar to that of Aspidiotus. Represented by a single described species.

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119. Aonidia lauri (Bouché).

Aspidiotus lauri Bouché. Schald (1833), 53.
Chermes lauri Bouché. Boisduval, Ent. Hort. (1867), 340.
Aonidia purpurea Targ.-Tozz., Catal. (1868), 43.
Aonidia lauri Bouché. Signoret, Essai, 1870, p. 103.

This species infests the leaves of the laurel (*Laurus nobilis*) in Europe. Targioni believes it to be the *Coccus aonidum* of Linnaeus; and, contrary to the established rules of nomenclature, renames it *Aonidia purpurea,* using the old specific name for the new genus. Signoret recognizes the new genus, but does not consider the species in question to be that described by Linnaeus. He therefore refers to it as *Aonidia lauri* Bouché.

Genus **LEUCASPIS** Targioni-Tozzetti

(Targioni-Tozzetti, Catal., 1868, 41 [without description]; Signoret, Essai, 1870, p. 100)

The last abdominal segment of the female is fringed with a series of blunt spiny hairs. The scales are similar to those of the females of Chionaspis. The arrangement of the spinnerets differs widely in the two known species.

120. Leucaspis signoreti Targ.-Tozz.

Leucaspis signoreti Targ.-Tozz., Catal. (1868), 42.
Leucaspis signoreti Targ.-Tozz. Signoret, Essai, 1870, 100.

Infests leaves of pine in Europe; scales of both sexes white, with exuviae light yellow.

121. Leucaspis pini (Hartig).

C. pini Hart., Jahr. über die Forsch. des Forstwers. (1839), 642.
A. pini Bouché, Ent. Zeit. Stett. (1851), XII. 110.
Leucaspis candida Targ.-Tozz., Catal. (1869), 41.
Leucaspis pini Hartig. Signoret, Essai, 1870, p. 102.

Infests leaves of pine in Europe.

LIST OF AMERICAN COCCIDAE NOT DESCRIBED IN THE PRECEDING PAGES

The following list includes the names of all the Coccidae not belonging to the subfamily Diaspinae which I have found described as occurring in North America. Owing to lack of time, but little effort has been made to determine the validity of the species enumerated. The genera and the species under each genus are arranged alphabetically.

122. Asterodiaspis quercicola (Bouché).

This species infests oak at Washington, D. C. See Agr. Report 1880, page 330, and Plate XI, fig. 9, of that report. A more careful study of this species has convinced me that it does not belong to the Diaspinae.

123. Carteria lacca (Kerr).

This is the insect which furnishes the lac dyes and the shellac of commerce. Although not an American insect, I have included it in this list on account of its economic importance. For description and figures, see my report in Agr. Report 1881, page 209 and Plate XIX.

124. Carteria larreae Comstock.

This is a lac insect which infests the creosote plant (*Larrea mexicana*), in the southwestern portions of the United States and in Mexico. See Agr. Report 1881, page 211.

125. Carteria mexicana Comstock.

This is a lac insect which infests mimosa at Tampico, Mexico. See Agr. Report 1881, page 212.

126. Cerococcus quercus Comstock.

Infests oak in Arizona and California. This species is remarkable for the large amount of wax which it excretes. See Agr. Report 1881, page 213.

127. Ceroplastes cirripediformis Comstock.

This species was found in Florida on myrtle, orange, quince, and a species of Eupatorium. See Agr. Report 1880, page 333.

128. Ceroplastes floridensis Comstock.

This species infests orange, lemon, fig, pomegranate, guava, tea, quince, Japan plum (Biotrites), oleander, red bay, sweet bay, gall berry (*Ilex glabra*), myrtle, and Andromeda, in Florida. See Agr. Report 1880, page 331, and Plate IV, figs. 2, 2*a*, and 2*b*.

From this species I bred a hymenopterous parasite of the genus Tetrastichus. See l. c. 369.

129. Ceroplastes jamaicensis White.

Infests trunk of lancewood tree in Jamaica. White, Ann. Nat. Hist., XVII, 333, and Westwood, Gardeners' Chronicle, 1853, 484.

130. Coccus bassi Targ.-Tozz.

This is a Mexican species mentioned by Targioni-Tozzetti, Stud. sulle Cocc., 1867, 27, and Catal. (1868), 32.

131. Coccus cacti of authors.

The cochineal insect occurs upon cactus in Florida. See Agr. Report 1880, page 346.

Coccus pinnicorticis Fitch.

This is the name given by Fitch (Trans. N. Y. State Agr. Society, Vol. XIV [1854], 871) to a plant louse which is often mistaken for a coccid.

132. Dactylopius adonidum of authors.

Coccus adonidum Linn., Syst. Nat. (1767), 740.
Dactylopius adonidum Signoret, Essai, 1875, 306.
Lecanium phyllococcus Ashmead, Canadian Entomologist, XI (1879), 160.

This is the common mealy bug. See Agr. Report 1880, 341.

133. Dactylopius destructor Comstock.

This is a mealy bug which is very destructive to oranges in Florida. See Agr. Report 1880, 342.

134. Dactylopius longifilis Comstock.

This is a mealy bug common on many plants in the conservatories at Washington. See Agr. Report 1880, 344.

Dorthesia.

See *Orthezia.* See also *Icerya purchasi,* which has been determined by several writers as a Dorthesia.

Dorthesia celastri.

Glover states (Agr. Report 1876, 45) that Dr. Fitch mentions a species, *Dorthesia celastri,* which is found on Celastrus. I have been unable to find the reference in Fitch's writings. But in the Fitch collection I saw what I believe to be the egg masses of *Euchenopa binotata* labeled with this name.*

Dorthesia viburni Fitch.

Under this name also Dr. Fitch distributed specimens of the peculiar egg masses of *Euchenopa binotata* Say. I cannot find, however, that the name was published.

135. Eriococcus azaleae Comstock.

Infests azalea. I have found it at Washington, and in a hothouse at Geneva, N. Y. See Agr. Report 1880, 338.

From this species I have bred the chalcid parasite *Coccophagus immaculatus* Howard. See Agr. Report 1880, 358.

136. Icerya purchasi Maskell.

Infests orange, rose, acacia, and many other plants in California. See Agr. Report 1880, 347.

137. Kermes galliformis Riley.

Infests oak. See Agr. Report 1880, 337, and American Naturalist, Vol. XV (1881), 482.

From species of Kermes I have bred the following chalcid parasites: a species of the genus Telenomus, and *Cosmocoma elegans* Howard. See Agr. Report 1880, pages 370 and 371.

138. Lecanium antennatum Signoret.

Infests oak. Described by Signoret (Essai, 1873, 413), from specimens received from Dr. Asa Fitch.

* For a description and figure of *Euchenopia binotata,* see Agr. Report 1876, page 28.

139. Lecanium caryae Fitch.

Infests hickory. See Trans. N. Y. State Agr. Society, 1856, 443. There is a typical specimen of this species in the collection of the above-named society. Mr. J. D. Putnam bred the chalcid parasite *Chiloneurus albicornis* Howard. See Agr. Report 1880, 363, and Plate XXIII, figure 4 (not Plate I, as stated).

140. Lecanium cerasifex Fitch.

Infests cherry. See Trans. N. Y. State Agr. Society, 1856, 368. From Fitch's notes it is evident that this species was described from two specimens. I saw one specimen in his collection in 1881. There is none in the collection of the N. Y. Agr. Society.

141. Lecanium corylifex Fitch.

Infests hazelnut. See Trans. N. Y. S. Agr. Society, 1856, 473. I have been able to find no specimens in existence labeled by Dr. Fitch as *L. corylifex.* But among the duplicates in the Fitch collection, I saw many specimens labeled *L. coryli.* And I have one which Professor Uhler received from Dr. Fitch labeled in the same way. In Dr. Fitch's notes on *L. corylifex,* he gives as a synonym of the species *Coccus coryli* (?) Lin., Sys. Nat., II, 741. I believe, therefore, that the specimens labeled by Fitch as *L. coryli* may be taken as the types of his *L. corylifex.* It is worthy of note that in no instance have I seen the word *type* written on one of his labels.

142. Lecanium cynosbati Fitch.

Infests stalks of wild gooseberry. See Trans. N. Y. State Agr. Society, 1856, 436. From Fitch's notes it is evident that this species was described from a single specimen. This specimen I saw in the Fitch collection in 1881.

143. Lecanium fitchii Signoret.

Infests raspberry or blackberry. See Signoret, Essai, 1873, 404.

144. Lecanium filicum Boisduval.

Infests ferns. Described by Boisduval in his Essai sur l'Ento-

mologie Horticole, 335. There is a fuller description by Signoret in his Essai, 436. Packard records* the presence of this species in this country.

145. Lecanium hemisphaericum Targ.-Tozz.

Infests orange, oleander, and many other plants. See Agr. Report 1880, 334.

146. Lecanium hesperidum Linn.

Infests oleander, orange, and many other plants. See Agr. Report 1880, 335. In addition to the three parasites enumerated in the report just quoted, I have bred *Coccophagus lecanii* (Fitch) from this species. See l. c., 357.

147. Lecanium juglandifex Fitch.

Infests butternut. See Trans. N. Y. State Agr. Society, 1856, 463. There is a typical specimen in the collection of the N. Y. S. Agr. Society.

148. Lecanium oleae Bernard.

This is what is known as the black scale in California. It infests orange, olive, oleander, and many other plants. See Agr. Report 1880, 336.

149. Lecanium persicae (Fabricius).

Infests peach. For description see Signoret, Essai, 1873, 407. Also Fitch, Trans. N. Y. State Agr. Society, 1856, 357.

150. Lecanium platycerii Packard.

Infests the staghorn fern (Platycerium). See Packard, *Injurious Insects*, etc., 1870, pages 28 and 31.

151. Lecanium pyri Fitch.

Infests pear. See Trans. N. Y. State Agr. Society, 1854, 809. Under this name Fitch has described two distinct species, one a Lecanium and the other a Pulvinaria. He evidently considered the former an immature stage of the latter. There is a typical

*Injurious insects, etc., 1870, p. 27.

specimen in the collection of the N. Y. S. Agr. Society which is a Lecanium; and I saw both a Lecanium and a Pulvinaria in the Fitch collection labeled *Lecanium pyri.*

152. Lecanium quercus (Linn).

Infests oak. For description, see Signoret, Essai, 1873, 427. The specimen which served as the type of Signoret's description was received from Dr. Asa Fitch.

153. Lecanium quercifex Fitch.

Infests white oak. See Trans. N. Y. State Agr. Society, 1858, 805. I have been unable to find any specimens labeled by Fitch as *Lecanium quercifex.* But there are in both the N. Y. State Agr. Soc. collection and the private collection of Fitch specimens labeled "White Oak Scale insect, *Lecanium querci.*" As white oak scale insect is the popular name given by Fitch in the published description of *L. quercifex,* I think these specimens must be those which he had before him when he wrote the description of *L. quercifex.*

154. Lecanium quercitronis Fitch.

Infests black oak. See Trans. N. Y. State Agr. Society, 1858, 805. Typical specimens of this species are in the collection of the N. Y. S. Agr. Society. This species is infested by the chalcid parasite *Coccophagus lecanii* Fitch.

155. Lecanium ribes Fitch.

Infests currant. See Trans. N. Y. State Agr. Society, 1856, 427. Although Fitch states that this species was common in some gardens, there are no specimens in the collection of the N. Y. S. Agr. Society; and in his private collection there is only a single specimen which is in very poor condition.

156. Lecanium sallei Signoret.

This is a Mexican species the food plant of which is unknown. See Signoret, Essai, 1873, 410.

157. Lecanium tiliae (Fitch).

Infests linden. See Fourth Annual Report of the Regents of the University of the State of New York (1851), page 69. I have been unable to find the type of this species in either of the collections where it should be.

158. Lecanium tulipiferae Cook.

Infests the tulip tree. See Canadian Entomologist, vol. X (1878), 192.

I think this will prove to be *Lecanium tiliae* (Fitch).

159. Lecanium verrucosum Signoret.

This is a Mexican species the food plant of which is unknown. See Signoret, Essai, 1873, 442.

160. Orthezia americana Walker.

Infests goldenrod (Solidago), burdock (Arctium), Impatiens, Eupatorium, and probably many other native plants. See Agr. Report 1880, 349.

After this genus had been established an effort was made to change the name to Dorthesia; hence we find both names in the books. See *Dorthesia*, above.

161. Pseudococcus aceris (Geoffrey).

Infests maple. See Agr. Report 1880, 345. This species is infested by the chalcid parasite *Rhopus coccois* (E. A. Smith). See l. c., 361.

162. Llaveia aximus (Hernandez).

This is a Mexican species which is said to be about one inch long (23 to 25 mm.). It infests *Jatropha curcas* and *Spondias myrobolanus*. Signoret states that it is employed in Mexico as a fat and as varnish, and that in its first state it appears to be used in medicine as an anodyne. See Signoret, Essai, 1875, 371.

163. Pulvinaria innumerabilis Rathvon.

Coccus innumerabilis Rathvon, Pennsylvania Farm Journal, Vol. IV (1854), 256–8.
Lecanium acericorticis Fitch. Trans. N. Y. State Agr. Soc., 1859, 775.
Lecanium acericola Walsh and Riley, American Entomologist, Vol. I, 14.
Lecanium maclurae Walsh and Riley, American Entomologist, I, 14.

This species infests maple, Negundo, grape, osage orange, and probably other plants. For figure, see Agr. Report 1880, Plate XI, fig. 6. In addition to the works cited above, interesting papers upon this species will be found in the Proceedings of the Davenport Academy of Sciences, Vol. II, and in the American Naturalist, Vol. XII, 655. See *P. vitis.*

From this species Mr. J. D. Putnam bred the chalcid parasite *Aphycus pulvinariae* Howard (see Agr. Report 1880, 365), and I have bred *Coccophagus lecanii* (Fitch) and the pyralid parasite *Dakruma coccidivora* Comstock (see Agr. Report 1879, 241).

164. Pulvinaria pyri (Fitch).

Infests pear. This is the *Lecanium pyri* of Fitch in part. Is it not the same as *Pulvinaria innumerabilis*?

165. Pulvinaria salicis (Bouché).

Infests willow. It was received by Signoret from Dr. Fitch. See Signoret, Essai, 1873, 44. Is not this also the same as *Pulvinaria innumerabilis*?

166. Pulvinaria vitis of authors.

Infests grape. See Signoret, Essai, 1873, 45. It may be that our *Pulvinaria innumerabilis* will prove to be identical with this species.

167. Rhizococcus araucariae (Maskell).

Infests Norfolk Island pine (Araucaria). See Agr. Report 1880, page 339.

168. Rhizococcus quercus Comstock.

Infests oak, gall berry, and grass. See Agr. Report 1880, page 340.

INDEX TO PLANTS

In the following list are given the names of the plants cited in this report as food plants of scale insects. The species which infest each plant are referred to by number. Certain species infest a large number of plants and are thus liable to be found on other plants than those indicated here. Among these species are nos. 10, 13, 15, 17, 132, 134, 148, and 146.

INDEX TO SCALE INSECTS

Except where the word *page* occurs, the figures refer to the numbers which the species bear in this report. Synonyms are in italics, and generic names in small capitals.

EXPLANATION OF PLATES

PLATE I

Organs of the last segment of adult females of the Diaspinae; diagrammatic; each letter has the same significance throughout.

a. Vaginal opening.

b. Anus.

c. Mesal group of spinnerets (anterior group of report for 1880).

d. Cephalo-lateral group of spinnerets (anterior laterals of report for 1880).

e. Caudo-lateral group of spinnerets (posterior laterals of report for 1880).

f^1, f^2, f^3. Lobes.

f^1. First pair of lobes, or mesal lobes.

f^2, f^2. Second pair of lobes.

f^3, f^3. Third pair of lobes.

g. Thickened lateral margin of segment.

h. Club-shaped thickenings of body wall.

i. Incisions.

j. Thickened margins of incisions.

k. Spines (not represented in figure 2, to avoid complication).

l. Plates (frequently described by authors as spines).

m, m^1. Wax ducts.

n. Elongated pores (Fig. 2).

PLATE II

Scales of the Diaspinae, from camera lucida drawings. 1, *Aspidiotus ficus*, female; 1*a*, male of same; 2, *Aspidiotus nerii*, female; 2*a*, male of same; 3, *Diaspis rosae*, female; 3*a*, male of same; 4, *Chionaspis furfurus*, female; 4*a*, male of same; 5, *Mytilaspis pomorum*, female; 5*a*, male of same; 6, *Parlatoria pergandii*, female; 6*a*, male of same; 7, *Parlatoria proteus*, female; 7*a*, male of same; 8, *Parlatoria zizyphi*, female; 9, *Uhleria camelliae*; 10, *Aspidiotus* (?) *parlatoroides*, female; 11, *Chionaspis* (?) *biclavis*.

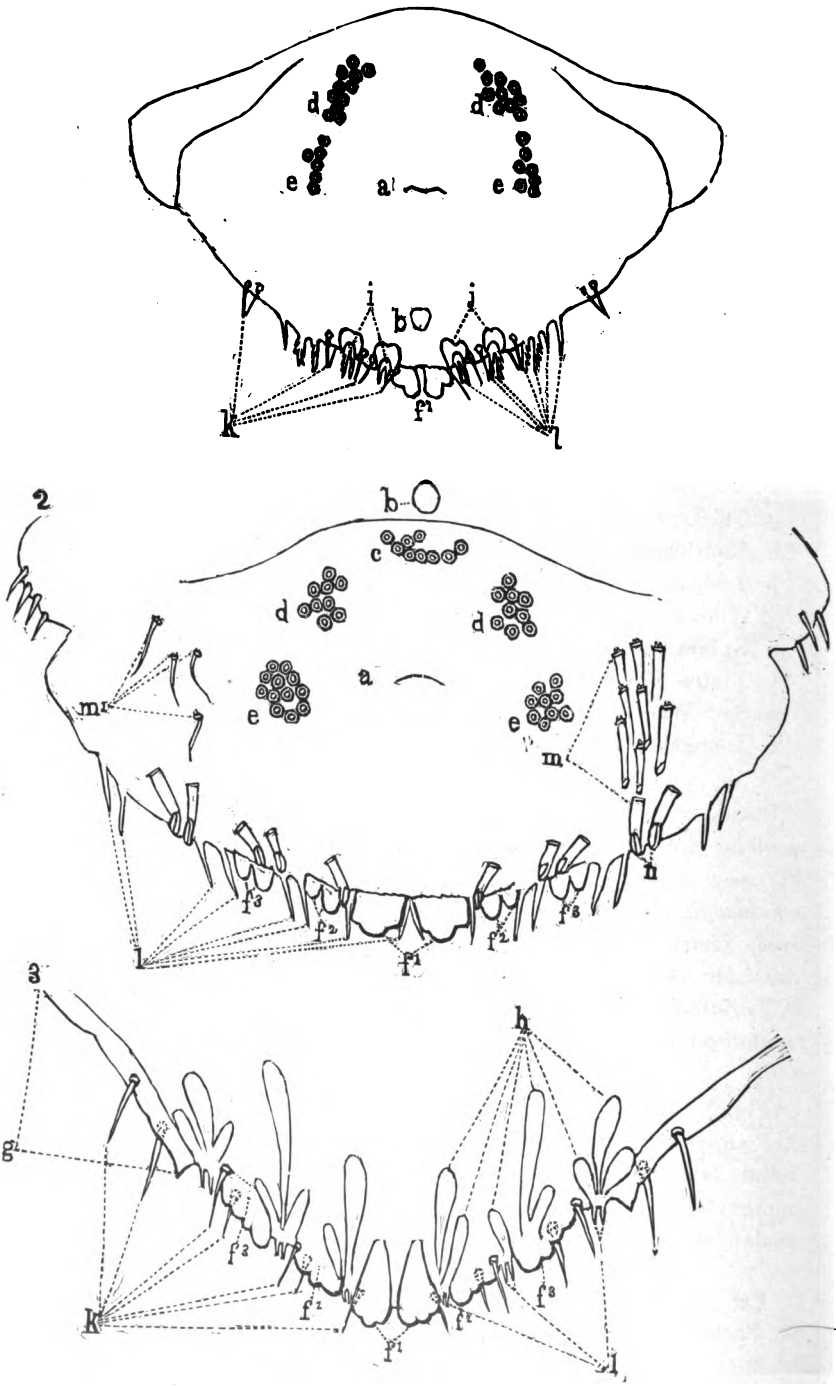
PLATE III

Fig. 1—1*c*, *Aspidiotus* (?) *sabalis*; 1, scales of male and female; 1*a*, antenna of male; 1*b*, antenna of female; 1*c*, last segment of adult female. Fig. 2, *Aspidiotus personatus*, female; 2*a*, caudal margin of same. Fig. 3, *Chionaspis spartinae*, last segment of female; 3*a*, margin of same.

PLATE IV

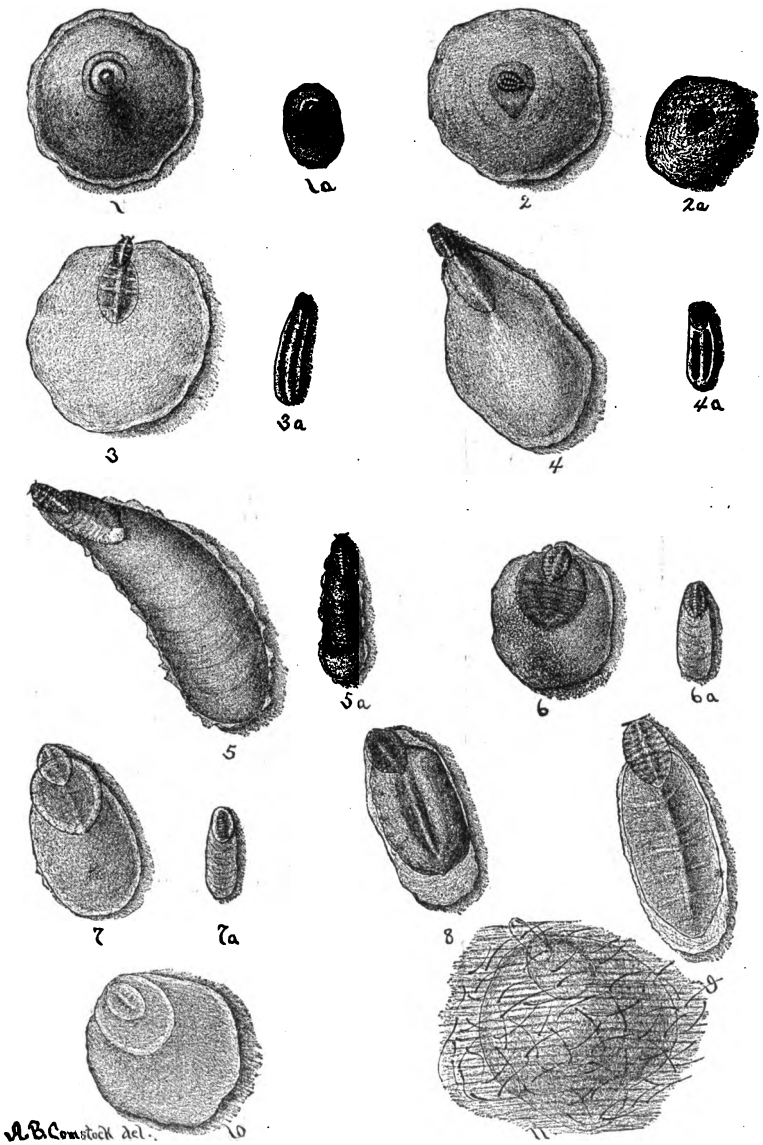
Fig. 1, *Parlatoria zizyphi*. Fig. 2, *Parlatoria pergandii*. Fig. 3, *Parlatoria proteus*. Fig. 4, *Parlatoria pergandii* var. *camelliae*.

PLATE I



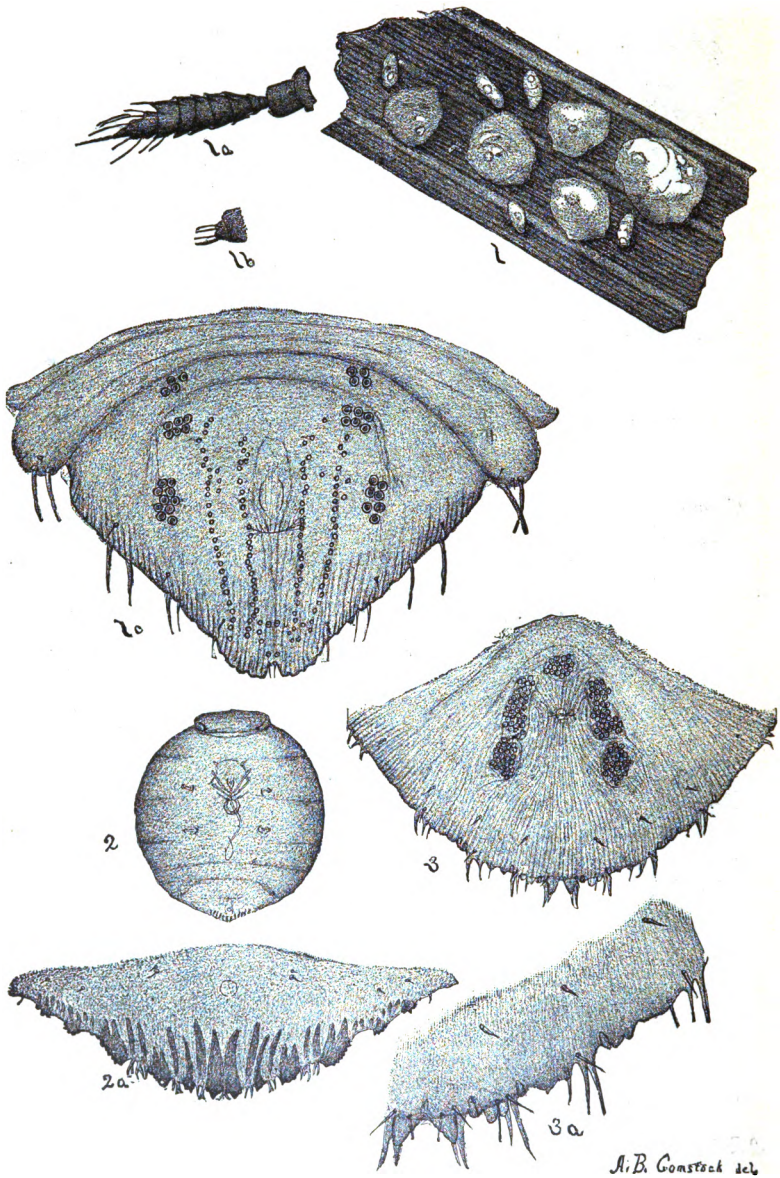
(Plate XXXIII, Cornell series)

PLATE II



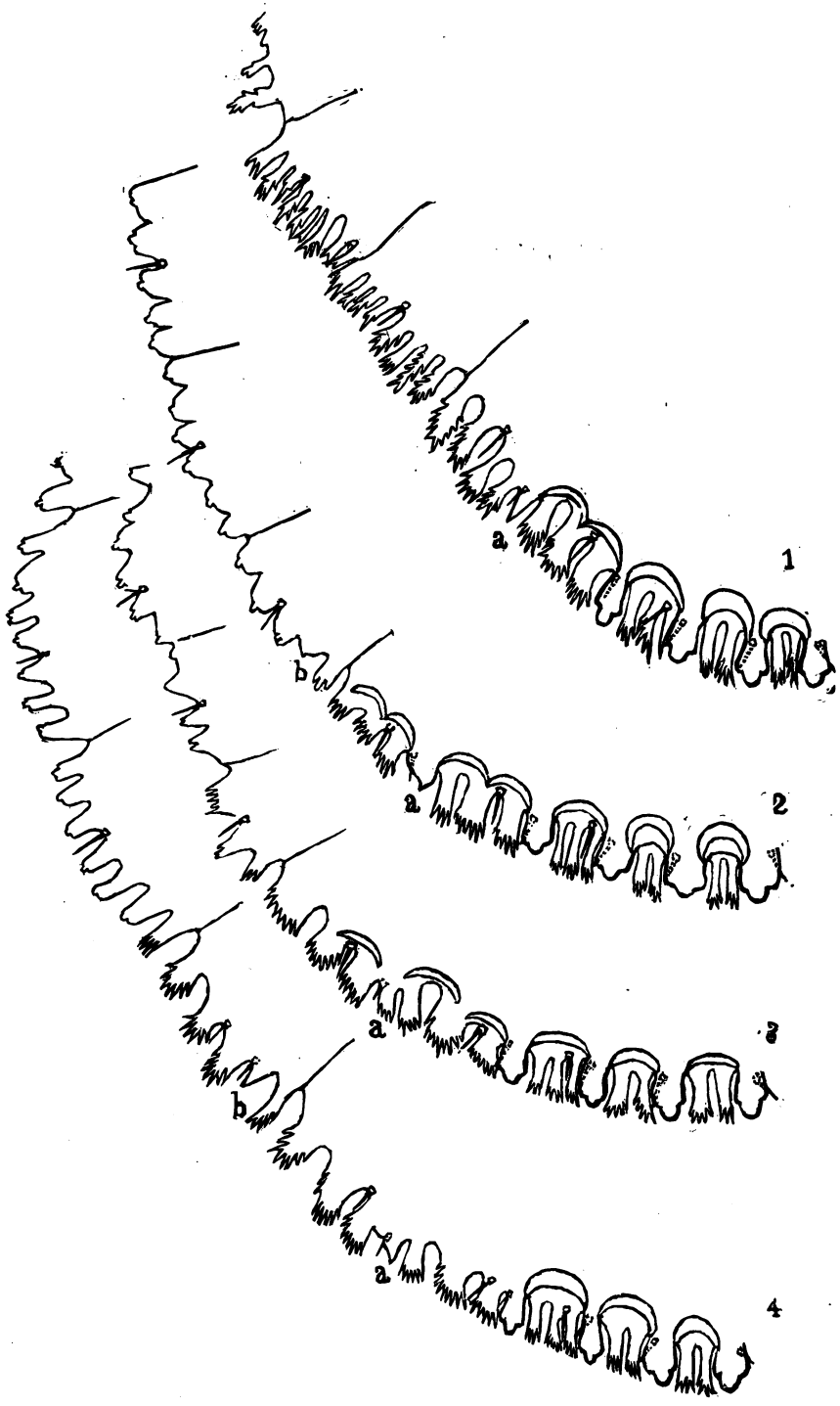
(Plate XXXIV, Cornell series)

PLATE III



(Plate XXXV, Cornell series)

PLATE IV



(Plate XXXVI, Cornell series)