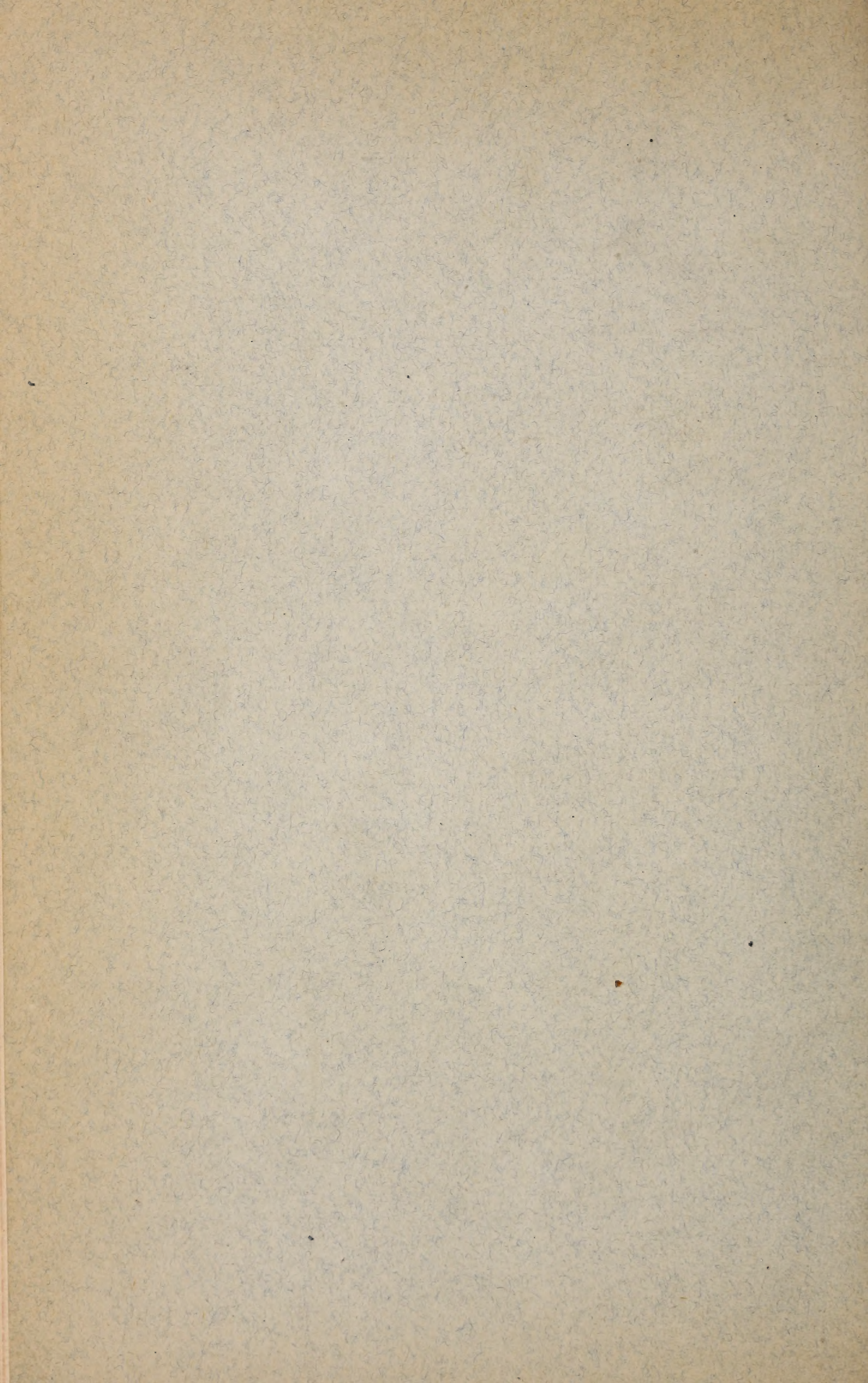


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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

THE SAN JOSE SCALE

AND ITS NEAREST ALLIES.

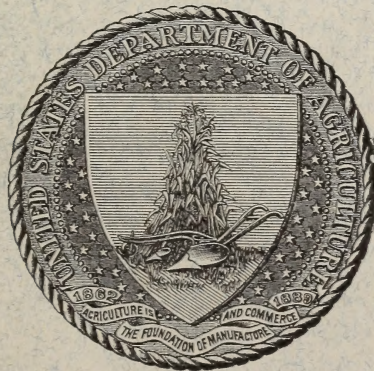
A BRIEF CONSIDERATION OF THE CHARACTERS WHICH DISTINGUISH THESE CLOSELY
RELATED INJURIOUS SCALE INSECTS.

Prepared under the direction of the Entomologist

BY

T. D. A. COCKERELL,

*Entomologist of the New Mexico Agricultural Experiment Station, Las Cruces,
New Mexico.*



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1897.

DIVISION OF ENTOMOLOGY

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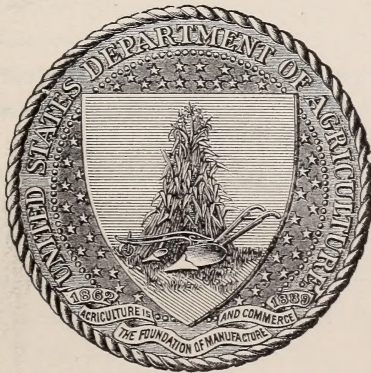
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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., April 26, 1897.

SIR: I have the honor to submit for publication the accompanying technical bulletin, which it is hoped will enable all entomologists as well as all other persons who have access to a compound microscope to distinguish definitely between the San Jose scale and its closest allies. This bulletin has been prepared under your authorization by Prof. T. D. A. Cockerell, whose long technical study of the scale insects has especially fitted him for the work. Although the specific characters of the San Jose scale have been given in a number of different publications, they have not been displayed by exact contrast to those of the most closely allied species, and it has resulted that almost all of the entomologists in the United States have felt themselves unable to decide authoritatively as to the identity of suspected forms, and have always forwarded specimens either to this office or Professor Cockerell in New Mexico for certain determination. It is the hope and expectation of the author of the bulletin and of the writer that by the aid of this account of the insect and its allies all of this uncertainty will be done away with and that much valuable time will be saved.

Respectfully,

Hon. JAMES WILSON,
Secretary of Agriculture.

L. O. HOWARD,
Entomologist.

CONTENTS.

	Page.
The preliminary examination	3
The study of the scale	4
The microscopic characteristics of the adult females.....	5
The subgenera and sections of <i>Aspidiotus</i>	9
The relationships of the San Jose scale.....	14
Habits of the species.....	16
Annotated list of the species of <i>Aspidiotus</i>	18
Postscript	31

THE SAN JOSE SCALE AND ITS NEAREST ALLIES.

By T. D. A. COCKERELL.

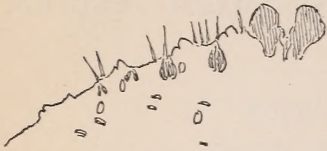
THE PRELIMINARY EXAMINATION.

Suppose that some objects suspected to be San Jose scales have been found upon a fruit tree. The first thing to do is to ascertain whether they are scales (Coccidæ) at all. I have known fly marks to be taken for Coccidæ, and occasionally the lenticels on the young growth of trees are supposed to be scale insects by those whose experience ought to have taught them better. It is really remarkable how the lenticels on cottonwood twigs in the Mesilla Valley, N. Mex., resemble a scale prevalent in that locality, *Aspidiotus juglans-regiæ* var. *albus*. From a short distance the deception would be complete but for the fact that the lenticels are arranged at approximately equal distances from one another and not massed like scale insects. Still more like coccids are certain fungi; I have on occasion been obliged to use a lens to ascertain which I had before me. At Mesilla, N. Mex.; I found on the dead wood of an apple tree a fungus which closely resembled the second stage, or immature male scales of the San Jose scale. This fungus was kindly identified for me by Mr. J. B. Ellis as the cytispora stage of *Valsa ambiens* Persoon. It is presumed that no entomologist will be misled for more than a moment by lenticels or fungi, but for those who are not entomologists it may be recommended to scrape the object with the finger nail or a knife blade, when, if it is a scale insect, it will readily come away, leaving at most only a pale film.

Granting now that we certainly have a scale insect before us, it is to be learned whether it belongs to the subfamily Diaspinæ. A mealybug has no scale—only some mealy or cottony secretion; a *Lecanium* or shield scale is itself the scale—that is, the insect becomes hardened and scale like, but has no scale separable from its body. But the Diaspinæ are small soft insects, in the adult ♀ stage without legs and unable to move, which secrete a scale separate from themselves, much like the shell of an oyster. With a lens it is easy to make out the insect and its scale, the latter having first been overturned with the point of a knife. The scale, it is further seen, carries the exuviae of the two first stages, or only one if it be a male.

Now, then, if we are sure that we have a Diaspine is it an *Aspidiotus*—the genus of the San Jose scale? In *Aspidiotus* the female scales are round, or nearly so, and the male scales vary from round to oval, according to the species, but are always of a similar texture to those of the female. Therefore we shall not be misled by *Mytilaspis*, in which

the female scales are elongate, pointed at one end; nor by *Chionaspis*, which have the female scales more or less pyriform in outline, and the male scales linear, soft, white, with the usually yellow larval skin at one end; nor by *Diaspis*, which has the female scale much like *Aspidiotus*, but the male scale like *Chionaspis*.



Diaspis piricola. on *Prunus*.
California.

FIG. 1.—*Diaspis piricola*: characters of female (original).

We may be misled by *Diaspis* if, as sometimes happens, we find only female scales. In Europe two similar species, one an *Aspidiotus* (*A. ostreaformis*), the other a *Diaspis*, were long confounded under one name. The *Aspidiotus piricola* recently described by Del Guercio, which I have recognized in specimens found on *Prunus* in California, is said by Berlese to be in reality the *Diaspis* just mentioned (see

fig. 1). I formerly saw only female scales, but have lately received those of the male, which are as in *Diaspis*. A figure is given so that the insect may be recognized by those who come across it.¹

THE STUDY OF THE SCALE.

With an ordinary pocket lens the characters of the scale can be made out. The following table may be found useful:

- A. Scale quite convex, about $1\frac{1}{2}$ mm. diameter, whitish with an ochreous or grayish tint, with a contrasting dark spot marking the exuviae, which are toward the side.
1. Scale somewhat translucent, so that it has a decided orange or yellowish tinge when covering the living insect; a species not extending above the lower austral zone. *A. rapax* Comst.
 2. Scale more opaque, thus appearing whiter; a species common in the upper austral zone, found mainly on poplars and willows. *A. convexus* Comst.

¹Attention is called to the four rudimentary lobes on each side, besides the large median ones, which are dark-colored. There is a well-marked median or anterior group of ventral glands, numbering at least eight. As Mr. A. C. F. Morgan remarked, in *Aspidiotus ostreaformis* the inner lateral margins of the median lobes are produced to encircle the anus, while there is nothing of the kind in the *Diaspis*. There has been some question as to what name this *Diaspis* should bear. Fitch's *Aspidiotus circularis* (Tr. N. Y. Agr. Soc., 1856) from stalks of currant at Albany, N. Y., has been thought referable to it, and would be the oldest name; but it doubtless belongs to *A. ancylus*, which Dr. Lintner has found on black currant in Albany. I do not recommend its use for *ancylus*, however, as it is an unrecognizable *nomen seminudum*, so far as Fitch's publication goes. The names *pyri* and *ostreaformis*, as applied to the *Diaspis* by Boisduval and Signoret, respectively, can have no claim, being merely misidentifications of Linnean and Curtisian species. We are thus obliged to fall back on Del Guercio's specific name, and call the insect *Diaspis piricola* (Del Guerc.); unless it can be proved identical with *D. pyri* Colvée, Ann. Soc. Ent. France, Bull., 1881, p. lii. The difficulty with regard to Colvée's insect arises from his account of the grouped ventral glands; he gives, caudolaterals 18 to 20, cephalolaterals 20 to 24, median never more than six, sometimes less or even none. In the *Diaspis* the median group is larger, while the others are smaller, viz, median 8 to 12, caudolaterals 8 to 14, cephalolaterals 12 to 13.

- B. Scale flattened, but comparatively large, diameter 3mm., or nearly; exuviae forming a slight prominence between the middle and the side, when rubbed so as to remove a thin film of secretion, appearing shining orange or foxy-red.
1. Scale grayish-brown.....*A. juglans-regiae* Comst.
 2. Scale white*A. juglans-regiae* v. *albus* Ckll.
- C. Scale flattened like the last, but smaller; diameter 2mm. or less.
1. Scale pale grayish, with a slight reddish tinge, the male scales suffused with blackish, exuviae of the ♀ scale somewhat to the side of the center, dull orange.....*A. howardi* Ckll.
 2. Scale blackish or dark gray to dull black, the exuviae when exposed a deep orange-red, their position somewhat away from the center.
 - a. Scale usually very dark, first skin hardly raised or nipple-like; a species common in the transition zone, often on maples.....*A. ancylus* Putn.
 - b. Scale somewhat paler, first skin somewhat raised and nipple-like, with faint indications of a dot and ring*A. forbesi* Johns.
 3. Scale of female gray, with the exuviae central, or nearly so, yellowish, ♂ scales showing a distinct dot surrounded by a ring, which is not the case in *A. howardi*.
 - a. ♂ scale all black, the dot and ring not distinguished by color, but distinctly sculptured; a Japanese species.....*A. andromelas* Ckll. n. sp.
 - b. ♂ scale grayish, hardly black, with a light dot and ring.
A. perniciosus Comst. (San José scale).
 - c. ♂ scale grayish black, the light dot and ring very conspicuous; occurs on orange and plum in Japan.....*A. perniciosus* v. *albopunctatus* Ckll.

The scale of *A. cydoniae* Comst., found on quince in Florida, resembles that of *rapax*. *A. crawii* Ckll. n. sp., a Mexican species, has also a convex scale, but the exuviae are not dark. The European *A. ostreaformis* Curt. has a black scale with deep orange exuviae, and could easily be taken for *ancylus*.

It has been a matter for dispute whether the San Jose scale can be certainly recognized in the field. Its effect on the tree, killing the branches, is characteristic, but hardly in any true sense diagnostic; while the reddening of the tissues of the plant adjacent to the scale is sometimes well marked with *A. ancylus* as well as with *perniciosus*. A little experience, however, enables one to recognize the ashy-gray, generally thickly massed scales of *perniciosus*, with the dot and ring of the male scale; as against the dark scale and contrasting reddish-orange exuviae of *ancylus*, or the similar scales of *ostreaformis* and *forbesi*. Nor will the very pale scale of *howardi*, found singly on plums, be likely to cause confusion. At the same time it is to be recommended that the diagnosis made in the field be in every case confirmed by examination of the insect under the compound microscope, if either locality or plant is new.

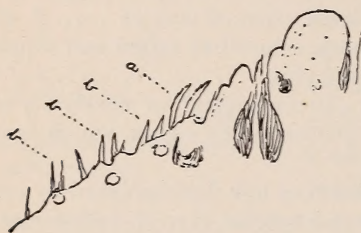
A. forbesi was only recently described from Illinois, but I have this year found it on apple trees in Mesilla, N. Mex., and it will probably be detected in other parts of America if looked for.

THE MICROSCOPICAL CHARACTERS OF THE ADULT FEMALE.

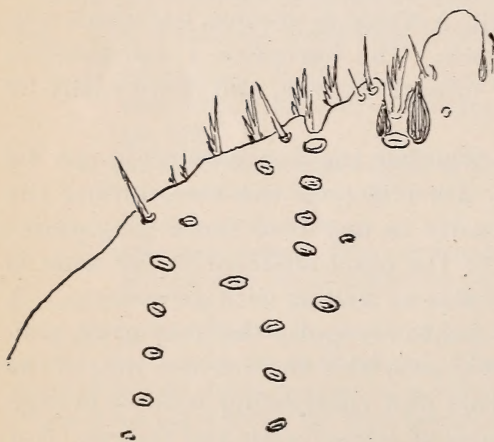
The female insect should be carefully removed from beneath the scale and boiled for a moment in strong liquor potassæ. It will then be transparent, and can be examined with a compound microscope. It

is the hind extremity of the insect which presents the characteristic features. I do not know whether it is the same with other people, but the writer can always judge best of the form of the parts when the tail is pointing upward, as in the accompanying figures. This is explained by the fact that the eye is more accustomed to judge of convexities (e. g., mountain ranges, tree tops, &c.) than concavities.

Having prepared the specimen, an examination shows various caudal structures, known as lobes, plates, and spines. The lobes are more or less rounded projections from the margin, of which there is a well-



A. perniciosus from Las Cruces (on plum), to show the glandular hairs or "plates".



A. howardi from Cañon Ag. on plum.

FIG. 2.—*Aspidiotus perniciosus* and *A. howardi*: characters of female (original).

developed pair (the median lobes) at the caudal extremity, and varying numbers of outer ones, according to the species. The plates, so called, are gland hairs, and form a delicate fringe adjacent to the lobes; they are often branched. The spines are fine bristles, placed at intervals on the margin, projecting more nearly at right angles than the plates.

Scattered over the surface of the hind part of the insect will be found oval glands, the position and number of which is often of importance. In connection with the glands at the bases of the lobes are found chitinous processes, which remain dark after boiling the insect in caustic potash, and are represented as dark fusiform objects in the figures.

The oval glands just mentioned are on the dorsal surface; but by changing the focus there will come into view, when present four or five groups of circular glands on the ventral surface, arranged about the genital

opening. When well developed, these ventral grouped glands consist of an anterior or median group and two groups on each side, known as caudolateral and cephalolateral. Their function has long been doubtful, but Mr. E. E. Green (Ent. Mo. Mag., April, 1896, pp. 85-86) has hit upon what is almost certainly their true purpose, namely, to secrete the waxy powder which dusts the surface of the eggs. In accordance with this view, we find them to be very numerous in those forms which produce numerous eggs; less numerous in those which produce a few eggs at a time, which rapidly hatch; and wanting in

those which are ovoviviparous, and give forth their young in an active state. They are also wanting in the immature females and the males. The San Jose scale is viviparous, and wholly lacks these ventral glands, while they are present in the adult females of the allied *Aspidiotus forbesi*, *ancylus*, *ostreaeformis*, *juglans-regiae*, &c. They are wanting in *A. rapax*, which however will not be confounded with *perniciosus*, having a strongly convex scale, with dark sublateral exuviae. If the grouped ventral glands are found, it may be assumed at once that the insect is not the San Jose scale; but it does not always happen that we have adult females under examination, so their absence, even though the scale be flattish, may not be conclusive. A little study of the

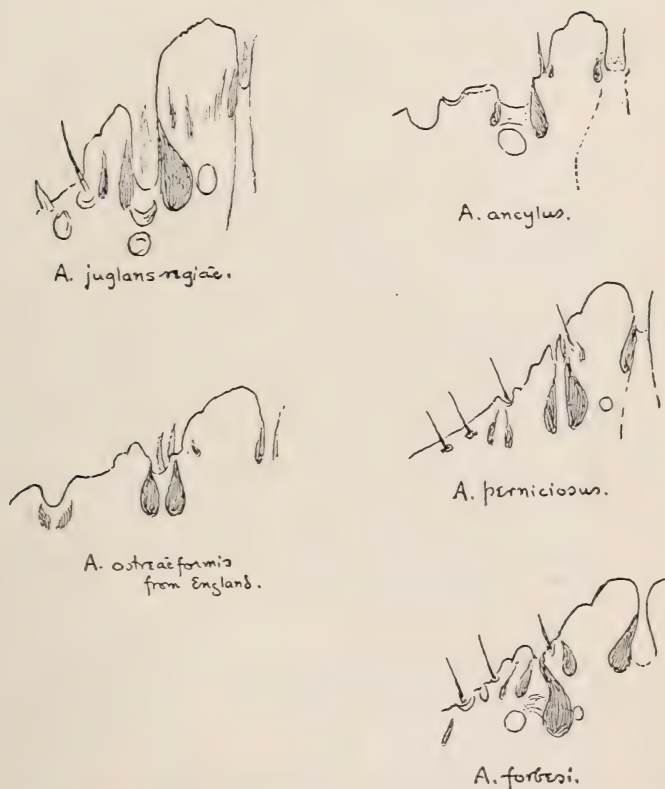


FIG. 3.—*Aspidiotus juglans-regiae*, *A. ancylus*, *A. ostreaeformis*, *A. perniciosus*, and *A. forbesi* (original).

accompanying figures will, it is hoped, remove all difficulty. It will be seen that in the true San Jose scale (*A. perniciosus*) the median lobes are large, upright, notched on the outer margin, though a little variable in form, as the different figures indicate. The second lobes are small but *distinct, quite close to the first*, variable in shape but inclined to be pointed, and notched also on the outer margin. The chitinous processes at the interval between the first and second lobes are *well developed, close together, and of nearly equal size*. Fig. 2 is designed to show the glandular hairs or "plates;" attention should be called to the fact that they are spine-like, at most feebly serrate, not branched; there is a large pair at *a* and three smaller pairs are shown at *b*. While the

small pairs of plates are quite characteristic, there is a fair amount of variation in these organs, and it is worth noting that if the specimens are boiled too long they are apt to be destroyed or detached.

In *A. ancylus* (fig. 3), the species most commonly confounded with *perniciosus*, it is seen that the shape of the median lobes is different, though these organs vary somewhat, and that *there is nothing but the merest rudiment of a second lobe*. It is further seen that the interval between the median lobe and the rudiment of the second is *very wide*, and that the chitinous processes are *far apart* and not of equal size, the innermost being the largest. There is also a gland orifice just below the interval. The plates of *ancylus*, not shown in the figure, are fringed and of the type shown in *howardi*, though less developed.

A. howardi (fig. 2) is of the type of *ancylus*, but the rudiment of the second lobe is somewhat more developed. The figure, from one

of the type specimens, sufficiently indicates the characters and includes the oval dorsal glands. It must be admitted that *howardi* is very close to *ancylus*; perhaps only a variety of it.

A. forbesi (fig. 3) is really a good deal nearer to *perniciosus* than is *ancylus*. It will be noted, however, that the median lobes are more or less *oblique*, and especially that the chitinous processes of the interval between the first and second lobes are *very unequal*, the inner being

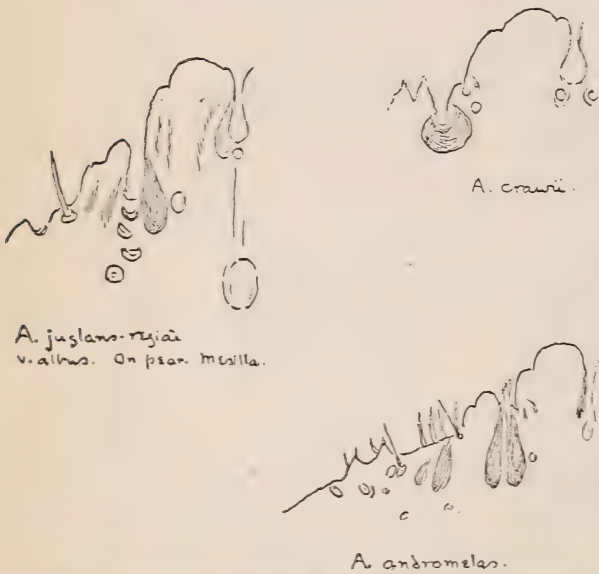


FIG. 4 —*Aspidiotus juglans-regiae* var. *albus*, *A. crawii*, and *A. andromelas* (original).

very large and curved, the outer *very small*. The second lobe is quite distinct; Mr. Johnson figures it as entire, but it is almost always deeply notched.

A. ostreaeformis (fig. 3), which has been found at Alameda, Cal., has the first and second lobes quite wide apart; but the second lobe, though small, is distinct. The form of the median lobes is somewhat peculiar.

A. juglans-regiae (fig. 3) and its var. *albus* (fig. 4) ought not to be confounded with *perniciosus* on account of large scale, but figures are given in case of any difficulty. The difference in the shape of the median lobes shown in the two figures is not a constant one, as between the type and variety. This species will be further known by the very well-developed rows of oval dorsal glands, which are extremely conspicuous in mounted specimens.

A. albopunctatus, now regarded as a variety of *perniciosus* and *A. andromelas* (fig. 4), both Japanese, do not differ from *perniciosus* by any marked structural characters; *andromelas* is easily recognized by its scale.

A. obscurus, which Mr. G. McCarthy reports as occurring rarely on peach in North Carolina (N. C. Exp. Sta., Bull. 138), belongs to a different section of the genus from the above, and is distinguished at once by the dark gray scale, with exuviae appearing pitch-black when rubbed. There are five groups of ventral glands, the median of as many as six.

The figure of *A. crawii* (fig. 4) illustrates the group of *rapax*, *convexus*, *cydonia*, etc. (subg. *Hemiberlesia* Ckll.), in which the median lobes are large but the others practically obsolete, or at best very minute. The plates are branched and crowded up toward the median lobes, making quite a dense fringe.

The following table of the grouped ventral glands may be found useful:

	Median.	Cephalo-laterals.	Caudo-laterals.
<i>A. perniciosus</i>	None.	None.	None.
<i>A. andromelas</i>	None.	None.	None.
<i>A. rapax</i>	None.	None.	None.
<i>A. juglans-regie</i>	0 to 4	7 to 16	4 to 8
<i>A. forbesi</i>	1 to 3	3 to 7	3 to 5
<i>A. ostreaformis</i> (from England)	6	11	9
<i>A. convexus</i>	None.	7	4
<i>A. ancylus</i>	0 to 6	6 to 14	5 to 8
<i>A. cydonia</i>	None.	8 to 9	5 to 7
<i>A. crawii</i>	None.	5	4
<i>A. vicia</i> (on grapevine)	0 to 2	4 to 9	3 to 8
<i>A. obscurus</i>	6	12	8
<i>A. howardi</i>	None.	6 to 7	3 to 4
<i>A. patavinus</i> (on cherry in Italy)	0 to 2	4 to 9	7 to 10

THE SUBGENERA AND SECTIONS OF ASPIDIOTUS.

Professor Comstock, in his second Cornell report (1883), gave a table of the American species of *Aspidiotus* known at that time. It ran somewhat as follows:

- A. Last segment of female with six groups of ventral glands. This includes *A. sabalis*, which is now placed in the genus *Comstockiella*.
- AA. Last segment of female with less than six groups of ventral glands.
 - 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. This is the subgenus *Chrysomphalus* Ashmead (type *A. ficus*), with the related groups *Melanaspis* n. subg. (type *A. obscurus*), *Mycetaspis* n. subg. (type *A. personatus*), and *Aonidiella* Berl. & Leon. (type *A. aurantii*).
 - BB. Second and third pairs of lobes smaller or wanting; caudal margin with two pairs of incisions, with thickened edges. This includes the subg. *Diaspidiotus* Berl. & Leon., with the related group *Hemiberlesia* (type *A. rapax*).
 - BBB. With neither elongated thickenings of the body wall nor incisions with thickened edges. This includes subg. *Aspidiotus* s. str. (type *A. nerii*); Comstock also placed here *A. parlatoriioides*, which belongs to *Pseudoparlatoria*. A figure is given of a Mexican specimen of this, showing some of the details more precisely than that of Comstock. It will be seen that it differs widely from any *Aspidiotus* in the characters of the female as well as those of the scale. Another species of this genus, *P. ostreata*, is very destructive to *Acalypha* in Jamaica.

A. nerii Bouché must be regarded as the type. It will be observed that the scale is light colored and the exuviae are not covered by secretion. The terminal lobes of the female are wide apart, and the plates (or glandular hairs) are well developed and strongly fringed. There are no deep depressions between the lobes, and the chitinous



Pseudoparlatoria parlatorioides.
on palms. from Mexico.

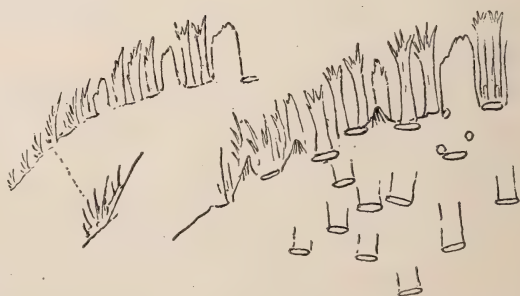
FIG. 5.—*Pseudoparlatoria parlatorioides* (original).

recent determination of *Parlatoria pergandii* from China and Japan (specimens quarantined by Mr. Craw) showing that the one apparently American species, if regarded as valid, is of foreign origin. This tolerably obvious affinity would of itself indicate that *Aspidiotus* s. str. belonged to the Old World; and a careful survey of the genus reveals the fact that there is no good reason for supposing that any species of this subgenus is a native of America. *A. destructor*, so common in the West Indies, is unquestionably a native of the eastern tropics, whence it was originally described. *A. abietis*, a modified form of this subgenus, might be thought surely native of America, being found in New York and Georgia, but it proves to be a well-known species of Central Europe; and against the probability of its being a native of both continents is the fact that it does not occur in the coniferous forests of the West, as does the really native *Chionaspis pinifolii*. It can not be doubted, I think, that *A. abietis* (incl. *pini*) is an introduction from Europe.

There are two peculiar West Indian species which represent a modified type of *Aspidiotus* s. str., viz: *A. sacchari* and *A. hartii*. The

processes at their bases are absent. The dorsal glands are very well developed (see fig. 6, *A. putearius*) and in form and position differ from those of other sections of *Aspidiotus*.

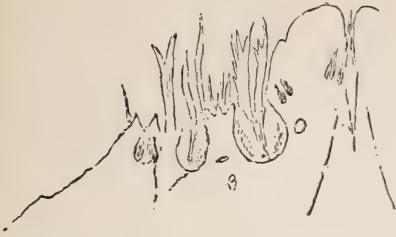
It will be noticed at the outset that in the fringe, and especially in the dorsal glands, there is indicated some relationship to those remarkable genera, *Parlatoria*, *Syngenaspis*, and *Leucaspis*. These three genera are exclusively natives of the Old World, the



A. putearius - Ceylon.

FIG. 6.—*Aspidiotus putearius* (original).

former occurs on sugar cane, the latter on yams, and I have not the least doubt that they were both introduced from the tropics of the Old World, though they have not yet been detected there. In certain features, and strikingly in the peculiar light purplish-brown tint of the scale, they are recalled by the Ceylonese *A. trilobitiformis*, which, however, departs more than they do from typical *Aspidiotus*. I am inclined to suppose that these resemblances indicate some real affinity.



*A. "cyanophylli" Green.
on Cycaos. Ceylon.*

FIG. 7.—*Aspidiotus cyanophylli* of Green (original).

We therefore dismiss *Aspidiotus* s. str. as not American. In the Old World it is quite abundant; especially, it would seem, in the warmer parts of the temperate zone. Just how many species are known can

not be stated, since several of those described are more or less questionable, either as to their validity or their position. There would seem to be about a dozen in Europe.

DIASPIDIOTUS (Berl. and Leon.) Ckll.

This subgenus was founded by Berlese and Leonardi for a mixture of species belonging to different groups. No type is designated, but *A. ancyllus* is included, and may be taken as the type. This is the group in which the scale is usually dark-colored; the exuviae are covered; the median lobes of the female are usually quite close together and much larger than the others, and there are between the lobes "incisions, with thickened edges." This is a circumpolar subgenus of the north temperate zone, living mostly on deciduous trees. Its food-plants and range coincide to a great extent with the subgenus *Eulecanium* of *Lecanium*.

In America this subgenus has several known species, and no doubt several await discovery. As we enter the tropics it almost disappears, or is replaced by the modified type *Hemiberlesia*; but in the West Indian region are two convex species which must be referred to *Diaspidiotus*—*A. punicea* and *A. diffinis*. It is unfortunate that we know so



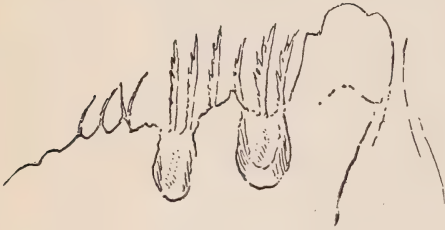
*A. trilobitiformis.
Ceylon.*

FIG. 8.—*Aspidiotus trilobitiformis* (original).

little of the coccidæ of the south temperate zone of the New World, but in Chile is found at least one native *Aspidiotus*, *A. latastei*, which must be regarded as a much modified *Diaspidiotus*.

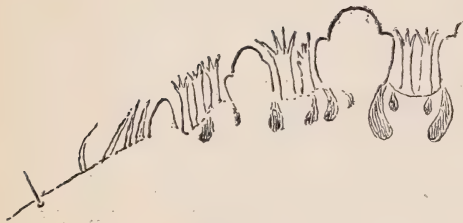
It is of interest to ask how far south *Diaspidiotus* goes in the Eastern Hemisphere. Mr. Green sends me a species found on *Cycas* in Ceylon, which he calls *A. cyanophylli*. But Signoret's *cyanophylli* belongs to *Aspidiotus* s. str., or at any rate is very close thereto, while Mr. Green's Ceylon species is a modified type of *Diaspidiotus*, largely comparable to the neotropical *Hemiberlesia*. I give a figure of the Ceylonese so-called *cyanophylli* (fig. 7). It may be named *A. greenii*.

Attention must also be directed to certain types which seem intermediate, more or less, between *Aspidiotus* s. str. and *Diaspidiotus*,



A. cydoniae. from one of the types of Mr.

while at the same time they recall *Chrysomphalus*. Such are *A. trilobitiformis* from Ceylon (fig. 8) and an apparently new species from England, which Mr. Newstead has taken for *A. hederæ* (fig. 9). No one could take *trilobitiformis* for a *Diaspidiotus*, but the so-called *hederæ* looks more like one at first sight. It may be said that as *Aspidiotus* s. str. is to *Parlatoria*, etc., so is *Diaspidiotus* to *Mytilaspis* and *Chionaspis*. The parallel is not exact, but it is approximate.



A. "hederæ", neot. immature ♀.
England. (from Newstead.)

FIG. 9.—*Aspidiotus* "*hederæ*" (after Newstead).

HEMIBERLESIA Ckll.

This name replaces the preoccupied *Aspidites* Berl. and Leon., but with a very different significance. The type is *A. rapax*; and *perniciosus*, *tenebricosus*, *smilacis*, and *minimus*, referred to *Aspidites* by Berlese and Leonardi, all belong

elsewhere—the first to *Diaspidiotus*, the next two to *Chrysomphalus*, and the last to *Aspidiotus* s. str. This subgenus really represents a southern modification of *Diaspidiotus*, with a convex scale and large median lobes, the others being suppressed. It appears to be exclusively American, and belongs to the tropical and lower austral regions, except that one species (*A. convexus*) occurs the upper Sonoran, and another (*A. ulmi*) in the corresponding zone in Illinois.

CHRYSOMPHALUS Ashm.

This subgenus must be credited to Ashmead, as at the time of publication Riley expressly disclaimed responsibility, though he had written the name first in his MSS. The first definition was given by Berlese and Leonardi; the type is *A. ficus*. In this subgenus the characters of the female are somewhat as in *Aspidiotus* s. str., but the chitinous

processes or tubular glands at the bases of the lobes recall the thickenings of a similar nature in *Diaspidiotus*, though they are much more developed, and are not accompanied by incisions. The scales are usually large, dark, and have covered exuviae.

The distribution of *Chrysomphalus* is quite remarkable. It seems to be quite at home in the neotropical region, but, very curiously, it sends northward a branch along our Atlantic coast, even to Washington (*A. tenebricosus*) and Massachusetts (*A. smilacis*). These northern forms lack the groups of ventral glands, and so are presumably viviparous. In the Old World it is significant enough that it appears in several very well-marked forms in Australia, but in Asia and beyond it seems to be lost, or greatly altered. It appears probable that in such types as *trilobitiformis* and the so-called *hederæ*, above alluded to, we see how it arose from *Aspidiotus* s. str., probably in the oriental or Australian region; while at the same time we have an indistinct hint of the manner of origin of *Diaspidiotus* to the northward.

From the point of view of geographical distribution, however, the striking thing is that while *Diaspidiotus* evidently reached America from the north, *Chrysomphalus* almost as evidently reached it from the south, and so may be taken as supporting the view that there formerly existed more land in the South Pacific Ocean. Had it been otherwise it seems incredible that there should be no native *Chrysomphalus* in Europe (unless the so-called *hederæ* be placed there) or on our Pacific slope.

It is to be observed that the male scale in *A. ficus* is almost round, a character which separates it at once from the similar *A. biformis*. In the Australian *A. cladii* the ♂ scale is considerably elongated.

MELANASPIS n. subg.

Type *A. obscurus*. This is a modified *Chrysomphalus* of American origin, with the exuviae black and the female with five distinct groups of ventral glands. Berlese placed it in *Diaspidiotus*, to which it is not related. The Mexican *A. nigropunctatus* also belongs here.

MYCETASPIS n. subg.

Type *A. personatus*. This appears to be a greatly modified *Chrysomphalus*. The small convex scale is very peculiar, as also are the characters of the ♀. Although this is a common West Indian insect, it is just possible that it had its origin somewhere in the Old World. Mr. Green's *A. artocarp*i from India, by the small very convex scale, the white scar with a black ring it leaves when removed, and some other characters, seems to be allied to *personatus*.

AONIDIELLA Berl. & Leon.

Type *A. aurantii*. This shows a decided affinity with *Chrysomphalus*, but yet is very distinct in some of its characters. Its place of origin is uncertain, but I incline to the opinion that it represents a northward extension of *Chrysomphalus* in the Chinese region.

TARGIONIA Sign.

Type *A. signoreti*. This seems to be a modification of *Aspidiotus* s. str., but I have never seen specimens.

ODONASPIS Leon.

Type *A. secretus*. A peculiar oriental type, of uncertain affinities.

PSEUDAONIDIA n. subg.

Type *A. duplex*. Includes also *A. theæ* and *A. trilobitiformis*. A remarkable Asiatic type. The "lattice-work" patch of the ♀ is shared by the genus *Ischnaspis*.

CRYPTOPHYLLASPIS n. subg.

Type *A. occultus*. A form discovered by Green in Ceylon, living in leaf-galls on *Grewia*.

SELENASPIDUS n. subg.

Type *A. articulatus*. Common in the West Indies, but very likely of African origin. Its similarity to *Aonidiella* is but superficial.

XEROPHILASPIS n. subg.

Type *A. prosopidis*. An extraordinary little form found in Arizona; superficially it recalls *Mycetaspis*.

There are some other subgenera indicated by species which I have not seen, or have but partially examined. The above need not now be discussed in detail; it will suffice to separate them out, so as to leave the larger groups fairly homogeneous.

THE RELATIONSHIPS OF THE SAN JOSE SCALE.

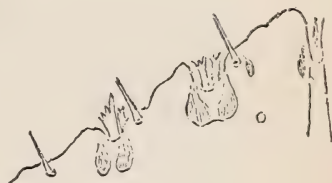
Having now cleared the way by the separation of the subgenera, we can more intelligently discuss the position of the San Jose scale, *A. perniciosus*, in the system. Berlese and Leonardi placed it in *Aspidites*, but it is, nevertheless, a *Diaspidiotus*, as that subgenus is now defined.

On comparing it with the other species of the subgenus, we arrive at some interesting conclusions. It is now to be shown, for the first time, that *A. perniciosus* is, with little or no doubt, a native of Japan. For it is in Japan that there occur two varieties or subspecies of *perniciosus*: *andromelas* and *albopunctatus*. These agree almost exactly in structural features with *perniciosus*, but the first differs markedly in the color of the scale; the second slightly in the scale, and more noticeably (from an economic point of view) in attacking *Citrus*. Mr. Alex. Craw, however, says (in litt., Feb. 11, 1897): "The only time that I have found *A. perniciosus* on imported stock was from Japan on some apple trees, the grafts of which were purchased in America." Mr. Craw has examined great quantities of fruit trees from Japan, so it must be admitted that his experience carries weight. But there are various Japanese scales which Mr. Craw has found only once, and several found by Mr. Takahashi on cultivated plants in Japan have not yet

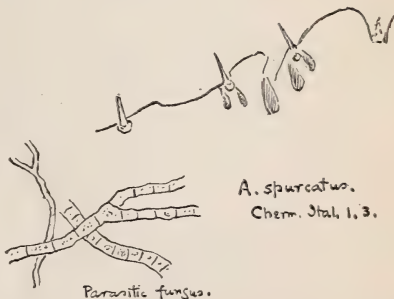
come into Mr. Craw's hands. It is only quite lately that Mr. Craw came upon *andromelas*. Further, if Japan is the native country of the San Jose scale, it is to be expected that it has there various natural enemies which keep it in check; it is not to be expected that it is found everywhere in quantities, any more than our native Diaspidinae are with us. Indeed, next time an economic entomologist goes to Japan he should make it his particular business to look up *A. perniciosus*, and see if there do not exist such natural enemies as are suggested, and whether, perhaps, one or more of them can be introduced into this country. It has been shown that *Diaspidiotus* enters the neotropical region, and this might be thought to favor the supposed Chilian origin of *A. perniciosus*. But even in the West Indies the type becomes largely modified as to the scale (*A. punicea*, *A. diffinis*), and greater still is the divergence of the Chilian *A. latastei*—all this not at all in the direction of *perniciosus*. While it is true that certain of our nearctic types do appear in a striking fashion in the southern parts of South America, I should be greatly surprised to receive from thence such a scale as *A. perniciosus*.

Still less can the supposed Australian origin be supported, as none of the native Australian species seem to belong to the same subgenus. Whether Maskell's "*Aonidia*" *fusca* is introduced *Asp. perniciosus*, it is difficult to say, but it would seem probable from what he has written on the subject. I am quite convinced, however, that the supposed variety of *perniciosus* recorded by Maskell as on *Eucalyptus* in Australia is not that insect; the description reads more like *A. forbesi*, but it is very likely something else.

It would seem that our native U. S. species of *Diaspidiotus* are not so very nearly related to those of Europe. An examination of such European types as *ostreaformis* (fig. 3), *betulae* (fig. 10), *spurcatus* (fig. 10), etc., shows a group not to be well matched in this country, noticeable for its broad, low, median lobes. The difference, indeed, is not very great—not so great as between some of our own species—but yet it is sufficiently obvious. In our species the median lobes are narrower, and usually more inclined to be notched on the outer margin. Thus they seem nearer to the Japanese type of *perniciosus*, etc.



A. betulae. from Bohemia.



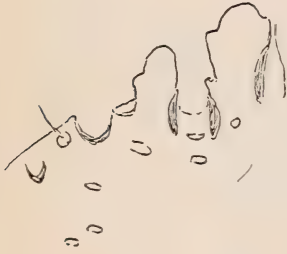
A. spurcatus.
Chem. Stat. 1, 3.

Parasitic fungus.

FIG. 10.—*Aspidiotus betulae* and *A. spurcatus* (original).

Of the American species, *A. forbesi* seems most to resemble *perniciosus* in the form of the lobes, etc., as will be evident from the figures. This insect is so far known only from several points in Illinois, and Mesilla, N. Mex. It is just possible that it also reached this country from Japan, since it was only described last year; but there is at present no good evidence in favor of such a supposition.

There is a tendency noticeable in our American *Diaspidiotus* to throw off a group with pallid, usually flatter scales, which occur on the peripheral parts of trees, the leaves, and even the fruit. Thus, from the type of *A. ancylus* we get *A. howardi*. I have lately received from



A. howardi.



A. comstocki.

FIG. 11.—*Aspidiotus howardi* and *A. comstocki* (original).

the Division of Entomology a specimen of *howardi* (fig. 11) out of the original Canyon City lot, apparently more adult, and certainly better developed, than those Prof. Gillette, the collector, sent to me. In the figure the great development of the second lobe will be noted, so well is it developed as to suggest a different species on comparison with fig. 2, but I have found similar differences in the second lobe in *coloratus* (even from the same tree) and *uva*. In all of the species the second lobe seems to vary more or less. The well-developed second lobe of *howardi* has led to its being confounded with *comstocki*. This latter insect, occurring on the leaves of maples, is very much like *howardi* in many respects, but is curious for the median and second lobes having their tips on the same level (fig. 11), or the median lobes even being exceeded by the second. This character is found also in the tropical *A. destructor*, which, however, is an *Aspidiotus* s. str.

The figure of *comstocki* given is from a specimen on sugar maple, Champaign, Ill.

A. juglans-regiæ is certainly a very distinct form, its scales almost suggesting a *Chrysomphalus*. It seems to have been described from Europe as *juglandis*, but I believe it is a native of America, more especially since it has a marked color variety (*albus*) found in New Mexico.

HABITS OF THE SPECIES.

It may be said that *A. perniciosus* mainly affects rosaceous trees and shrubs. It is quite bad upon garden roses. Fearing that some of the published records might not be reliable, I asked Dr. Howard for a list of the food plants on which the scale had actually been seen at the

Division of Entomology. Here is the list as given: Apple, crab apple, quince, pear, Bartlett pear, dwarf Duchesse pear, plum, Japan plum, Satsuma plum, *Prunus pissardi*, *Prunus maritima*, peach, apricot, almond, cherry, Rocky Mountain dwarf cherry, currant, black currant, *Citrus trifoliata* (this should have been *albopunctatus*), Osage orange, grape, elm, cottonwood, European linden, American chestnut, *Pyrus japonica*, *Catalpa bignonioides*, walnut, Japan walnut, loquat, red dogwood, junberry, rose, sumac, *Photinia glauca* (does this refer to *andromelas*?), Carolina poplar.

Thus the habitat on rosaceous plants is confirmed. As to the exceptions, too much stress should not be laid upon them, unless, perchance, some indicate the beginning of a new race, such as *albopunctatus*. I do not find the scale to infest the Osage orange nor the grape vines in the Mesilla Valley, even when they are grown abundantly in the vicinity of sealy orchards.

So far as we know, *A. forbesi* has similar food habits, but *A. ancylus* is different. This last is especially a maple species, and will flourish also on *Populus*, *Quercus*, etc.; it does not seem to take very kindly to fruit trees as a general rule. *A. ancylus* also does well (probably best) in the transition zone, whereas *A. perniciosus* belongs to the upper Austral.

As to the time of hatching, I have not statistics for the various species. At Las Cruces, N. Mex., I found *A. perniciosus* to begin producing young as early as April 26. A somewhat later date is given for other localities.

The manner of attack is different, more or less, in the various species under discussion. *A. ancylus*, on fruit trees, will be found upon the smaller branches, but in my experience more or less scattered, rarely in any great quantity. *A. perniciosus* is found largely upon the branches, becoming very abundant, covering and killing them. On the young shoots the reddening effect is very marked, though *ancylus* will also produce reddening. *A. forbesi*, as seen on apple trees in Mesilla, occurs largely under loose bark on the trunk, wintering there in numbers, and only invades the branches in limited quantity. Thus, there may be quite a lot of *forbesi* on a tree without its being noticed. *A. juglans-regie* occurs on the trunk and twigs, more or less scattered, or in little groups.

ANNOTATED LIST OF THE SPECIES OF ASPIDIOTUS.

ASPIDIOTUS Bouché.

Palæarctic.

- A.** (*Aspidiotus s. str.*) *abietis* Schr.—♀ scale dark gray, margin lighter, exuviae covered. ♀ with three pairs of lobes, plates divided at ends, ventral grouped glands present. ♂ orange, with the thoracic band very dark. Europe and N. Y. *A. pini* Comst. is the same species.
- A.** (*Aspidiotus s. str.*) *affinis* Targ.—♀ scale circular, with central exuviae; 6 lobes; scale-like plates; grouped glands present. On *Ruscus aculeatus*. Italy.
- A.** (*Aspidiotus*) *betulæ* Baer.—♀ scale plumbeous, with an orange spot indicating the place of the covered exuviae. The scale is much like that of *A. ancylus*. On bark of birch in Europe. Said to occur in New Jersey.
- A.** (*Aspidiotus s. str.?*) *calderii* Targ.—♀ scale thin, circular, pellucid, white; exuviae central; median lobes very large; grouped glands wanting. ♂ scale elliptical. On *Daphne*.
- A.** (*Aspidiotus s. str.*) *ceratoniae* Sign.—Allied to *nerii*, but differs in the ♂, which has the thoracic band almost invisible, etc. On *Ceratonia* at Nice.
- A.** (*Aspidiotus s. str.*) *ericæ* Boisd.—Resembles *nerii*. On *Erica mediterranea* in France. (Nomen seminudum.)
- A.** (*Aspidiotus s. str.*) *denticulatus* Targ.—♀ scale thin, transparent; grouped glands wanting. On *Rubia peregrina*. Italy.
- A.** (*Aspidiotus s. str.*) *genistæ* Westw.—On *Genista*. Similar to *A. nerii*. (Nomen seminudum.)
- A.** (*Aspidiotus s. str.*) *gnidii* Sign.—On *Daphne gnidium*. Similar to *A. nerii*. (Nomen seminudum.)
- A.** (*Aspidiotus s. str.*) *hederæ* Vall.—♀ scale yellowish-brown, exuviae central and yellow. ♀ with 6 lobes. On ivy, holly, and box.
- A.** (*Aspidiotus*) *hippocastani* Sign.—♀ scale circular, blackish, exuviae central and yellow. ♀ with the median lobes large; grouped glands present. On horse-chestnut.
- A.** (*Aspidiotus?*) *ilicis* Sign.—♀ scale grayish-yellow, exuviae nearly marginal; grouped glands four in number. On *Quercus ilex*. France. (Essai, 1869, p. 123.)
- A.** (*Aspidiotus*) *juglandis* Colv.—♀ scale small, reddish, almost always isolated; i. e., not massed. ♀ with two pairs of lobes, the median ones much the largest; four groups of ventral glands, cephalolaterals 8 to 12, caudolaterals 6 to 9; a single orifice marking the median group. The rows of dorsal glands, four in number, are very well marked; the first of 3 or 4, the second of 7 or 8, the third of 22 to 24, and the fourth of 16 to 18. Found in Catalonia, NE. Spain. I think this is the same as *A. juglans-regiæ*; both were published in 1881. I do not know which has priority. This is not *A. juglandis* Fitch, 1856, which is *Mytilaspis pomorum*.
- A.** (*Aspidiotus s. str.*) *lentisci* Sign.—♀ scale yellowish-brown; allied to *nerii*. S. France and Algeria.
- A.** (*Aspidiotus s. str.*) *minimus* Leon.—♀ scale suboval. ♀ yellow, very large median lobes, a smaller second pair, no groups of ventral glands. The small ♀ scales, less than a mm. diam., are found on the leaves of *Quercus ilex*. Portici, Italy. (Riv. Pat. Veget., IV, 350.)

- A. (*Diaspidiotus*) *niger* Sign.—♀ scale circular, black, exuviae yellow; two lobes; no grouped glands. On willow. France. (Essai, 1869, p. 130.)
- A. (*Aspidiotus* s. str.) *oleæ* Colv.—On the olive in Spain, producing yellow spots on the fruit at the points attacked. Through the kindness of Dr. Howard I have been able to see the "Gaceta Agricola del Ministerio de Fomento," Vol. XIV, No. 2 (1880), containing Colvée's description. The insect is said to most resemble *A. nerii*, *ceratoniae*, and *villosus*, and we are told how these three differ from it, without any direct statement of its specific characters. It seems to be nearest to *nerii*, differing only in the ♂. It is worth while to remark that in the same paper there is described a *Diaspis oleæ* Colv., which has escaped the notice of coccidologists. This may not be a *Diaspis*, as the ♀ scale has a black spot in the middle marking the exuviae, and ♂ scale is dirty gray. The ♀ itself is of an intense mulberry color.
- A. (*Subg.* ?) *oleastri* Colv.—Description not seen. Described in "Nuevos Estudios sobre algunos insectos de la familia de los Coccidos." (Valencia, 1882.)
- A. (*Diaspidiotus*) *ostreaeformis* Curt.—♀ scale, similar to that of *A. ancylus*. ♀ with four lobes, the median pair much the largest. Western Europe. *A. pyri* Licht., is the same. See Douglas, Ent. Mo. Mag., XXIII, 239; Morgan, Ent. Mo. Mag., XXV, 350. It occurs on apple, plum, cherry, and *Calluna vulgaris*. Also on peach at Isleworth, England (G. M. Fenn.). I found English specimens of this species to be attacked by a fungus similar to that which destroys American species of *Diaspidiotus*. I have seen it from Alameda, Cal. (Div. Ent., 351k.)
- A. (*Diaspidiotus*) *oxyacanthæ* Sign.—♀ scale blackish-gray, exuviae yellow; median lobes large; grouped glands present. On *Crataegus oxyacantha*.
- A. (*Diaspidiotus*) *patavinus* Berl.—♀ scale oval, fuscous or fuliginous, exuviae not central, length of scale nearly $1\frac{1}{2}$ mm. ♀ much as in *A. spurcatus* or *A. vitis*, median lobes large and broad, second lobes low, separated by a wide interval from first, plates serrate, four or five groups of ventral glands. On bark of cherry. Italy. (Riv. Pat. Veget., IV, 350.)
- A. (*Targionia*) *signoreti* Comst.—♀ scale black, very convex, exuviae central. On *Cineraria maritima*. France. (Sign., Essai, 1870, p. 106; Comst., Cornell Rep., 1883, p. 82.) *Targionia nigra* Sign. is the same.
- A. (*Diaspidiotus*) *spurcatus* Sign.—♀ scale blackish-brown, exuviae yellow. Grouped glands present. On poplar. France. Essai, 1869, p. 138. A variety on *Platanus orientalis* in Italy. (Berl. and Leon., Cherm. Ital., Fasc. 1.)
- A. (*Diaspidiotus*) *tiliæ* Sign.—♀ scale gray; only two lobes; grouped glands present, lateral groups of 9 or 10, median group of 7 or 8. This species is probably widely distributed in Central Europe; Dr. M. Hollrung has a reference to it in his Halle Bulletin of 1894.
- A. (*Diaspidiotus*) *villosus* Targ.—♀ scale circular, grayish, depressed, exuviae not central. ♀ with two lobes; groups of ventral glands of about 3 each. On leaves of olive.
- A. (*Diaspidiotus*) *vitis* Sign.—♀ scale dark gray, exuviae more or less covered; when rubbed the exuviae are brilliant black. ♀ with only two lobes. On *Vitis*, near Nice; on raisins from Algiers.
- A. (*Diaspidiotus*) *zonatus* Frauenf.—♀ scales gray or even nearly black, exuviae reddish-yellow. ♀ with two pairs of lobes; grouped glands usually absent, but once reported as present by Morgan. The ♀ scales occur upon the branches, the ♂ scales upon the leaves, of oak. Widely distributed in Europe. *A. quercus* Sign., is the same. See Morgan, Ent. Mo. Mag., XXIV, 207, and XXV, 120; and Newstead, Ent. Mo. Mag., N. S., IV, 279. 1893. Morgan figures the ♂.

Japanese.

- A. (*Diaspidiotus*) *andromelas* Ckll.**—Resembles *A. perniciosus*; exuviae of male scale wholly black, without any light dot and ring. On "*Phœtenia glauca*"—I find no such name in the Index Kewensis.
- A. (*Pseudanidia*) *duplex* Ckll.**—♀ scale subcircular, moderately convex, dark blackish brown; exuviae nearly at the side, orange. ♀ with very large median lobes, and three other pairs of very small lobes; plates scale-like; four large groups of ventral glands, and two orifices representing the median group; lattice-work pattern as in *A. theæ*. Japan. On camellia, orange, camphor, azalea, tea, *Olea fragrans*, etc. On azalea in Washington, D. C. (Div. Ent.)
- A. (*Diaspidiotus*) *perniciosus* var. *albopunctatus* Ckll.**—♂ scale with the pale dot and ring very distinct. Japan. On orange. Also found by Mr. Craw on plum from Japan.
- A. (*Odonaspis*) *secretus* Ckll.**—♀ scale white, shiny; exuviae exposed, shiny, rather large, very pale yellow, placed rather to one side. ♀ when adult with a single (median) lobe, as is the case also with *A. unilobis*; two elongated groups of ventral glands, with 80 to 90 orifices in each. On bamboo in Japan; on *Arundinaria* in Ceylon. (Green, Coccidæ of Ceylon, p. 47, Pl. XV.)

Nearctic.

- A. (*Diaspidiotus*) *æsculi* Johns.**—♀ scale about $2\frac{1}{2}$ mm. diam., dirty gray, exuviae covered, orange-red when rubbed. ♀ yellow, only one pair of lobes, plates simple, spines prominent; four groups of ventral glands, cephalolaterals 5 to 17, caudolaterals 4 to 11. On bark of *Æsculus californica*. California. (Bull. Ill. Lab. N. H., IV, 387.)
- A. (*Diaspidiotus*) *ancylus* Putn.**—♀ scale nearly circular; exuviae sublateral, reddish when the covering film is removed. The ♀ has ventral grouped glands. On ash, maple, beech, linden, oak, osage orange, peach, hackberry, bladder nut, and water locust. Iowa, New York, etc. Putnam, in Trans. Iowa Hort. Soc., 1877, p. 321, says the scale is usually of a light drab color, which certainly does not accord with what we commonly know as *ancylus*. However, he probably examined old scales, which eventually become pallid; and from the rest of his writings on the insect there can hardly be any doubt as to what was intended. He refers to the eggs.
- A. (*Hemiberlesia*?) *bigeloviæ* Ckll. n. sp.** (Fig. 12.)—♀ scale on twigs, like that of a *Hemiberlesia*, size and shape of *A. rapax*, but dull grayish-brown; exuviae placed to one side as in *rapax*, when rubbed shining black, but more or less covered by a film of white secretion. Removed from twig the scales leave a white patch. ♀ circular, deep brownish-orange; no groups of ventral glands; no plates; lobes subobsolete. See the figure, which is from a ♀ full of embryos. Los Angeles, Calif., on *Bigelovia brachylepis*. (Div. Ent., 4973, coll. by D. W. Coquillett.) I do not know whether or not to consider this an extremely degenerate type of *Hemiberlesia*; it is certainly very peculiar.
- A. (*Diaspidiotus*) *coloratus* Ckll.**—♀ scale about $1\frac{1}{2}$ mm. diam., broad oval, flat, dull pale orange-brown; exuviae concolorous, first skin somewhat paler. ♀ much like *wæ*; ventral glands present. On *Chilopsis* in the Rio Grande Valley, N. Mex.
- A. (*Diaspidiotus*) *comstocki* Johns.**—♀ scale rather flat, cream-buff, the part covering the exuviae brownish or concolorous. ♀ pale yellow; two pairs of well-developed lobes, the tips of the median pair below the level of the tips of the second pair, after the manner of *A. destructor*; 4 groups of ventral glands, cephalolaterals of 6, caudolaterals of 4. On leaves of sugar maple. Illinois and New York. (Bull. Ill. Lab. N. H., IV, 383.)
- A. (*Hemiberlesia*) *convexus* Comst.**—♀ scale similar to that of *rapax*, but more opaque. Grouped glands present. On poplar and willow.

A. (*Hemiberlesia*) *cydoniæ* Comst.—♀ scale like that of *rapax*. ♀ with four groups of ventral glands, differing from *convexus* in having only two pairs of interlobular incisions, and the plates more prominent. On quince in Florida. Maskell reports it on *Citrus* from Samoa, and Green on fig, *Citrus*, etc., at Punduloya, Ceylon. Dr. Howard informs me that it has never been received at the Department of Agriculture since 1880, so it must be rare in America.

A. (*Diaspidiotus*) *forbesi* Johns.—♀ scale much like that of *A. ancylus*. ♀ yellowish, with two pairs of lobes; 5 groups of ventral glands. On cherry, apple, pear, plum, quince, currant, and perhaps other trees. Illinois, and Mesilla, N. Mex.

A. (*Diaspidiotus*) *howardi* Ckll.—♀ scale flat, circular, pale grayish; exuviae covered, dull orange. ♀ very similar to that of *A. ancylus*, but two pairs of lobes. On plum, Canyon City, Colo.; Albuquerque, N. Mex.

A. (*Diaspidiotus*) *juglans-regiæ* Comst.—♀ scale circular, flat, grayish-brown, exuviae covered; diam. of scale, 3 mm. ♀ with two or three pairs of lobes; grouped glands present. On English walnut in California;

on locust, pear, and cherry in New York and District of Columbia.

var. *pruni* Ckll.—♀ with the oval pores more numerous, the fourth or external row of about 20. On plum, Las Cruces, N. Mex.

var. *albus* Ckll.—♀ scale white; exuviae orange-red, covered by white secretion. Mesilla Valley and Las Vegas, N. Mex.

A. (*Pseudodiaspis* n. subg.) *larreæ* Ckll., n. sp. (Fig. 13.)—♀ scales abundant on a stem

of *Larrea tridentata*; scale about 2 mm. diam., flat, irregular, round to suboval, dull white with a slightly creamy tint; exuviae not visible in the mature scale, but in younger scales the elongate-oval, pale straw-colored first skin is exposed, sub-lateral or even quite lateral. ♀ circular, not chitinous; only one pair of lobes; these broad and low, close together but not touching; no plates; no groups of ventral glands. The ♀'s contain embryos, which even after boiling remain sepia brown.

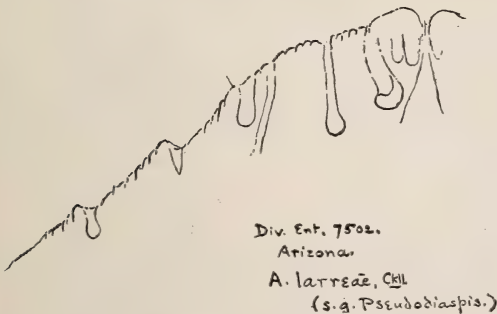


FIG. 13.—*Aspidiotus larreæ* (original).

A dried ♀ is oval, orange, with prominences on the margin. ♂ scale small, elongate, mytiliform, white, with the elongate first skin projecting at the small end, like a *Mytilisps*. Yuma, Ariz. (Div. Ent., 7502, coll. by H. G. Hubbard). This curious species is for the present left in *Aspidiotus*, because it seems to have points in common with the Indian *A. moorei*, Green. *Pseudodiaspis* will, however, no doubt eventually be regarded as a distinct genus, on account of the mytiliform ♂ scale and other characters.

A. (*Melanaspis*) *obscurus* Comst.—♀ scale very dark gray, only slightly convex; exuviae sub-lateral, covered; diameter of scale 3 mm.; ♂ scale oval. ♀ with three pairs of well-developed lobes; 5 groups of ventral glands. On willow-oak at Washington, D. C.

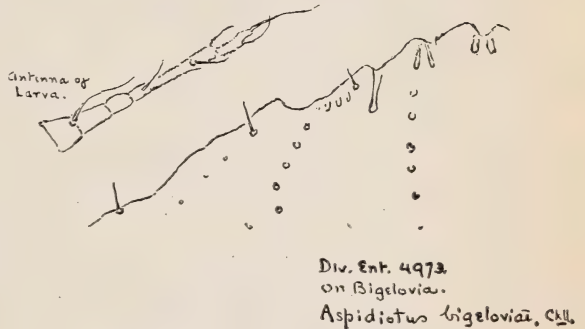


FIG. 12.—*Aspidiotus bigeloviae* (original).

- A. (*Chrysomphalus*) *perseæ* Comst.—♀ scale circular, flat; exuviae nearly central and covered; outer part of scale dark reddish-brown, that covering exuviae from dark gray to black; diam. of scale from $1\frac{1}{2}$ to 2 mm. Has a general resemblance to *A. ficus*. ♀ with 4 groups of ventral glands. On *Persea carolinensis*, Florida. Mexico, on cocconut palm.
- A. (*Xerophilaspis*) *prosopidis* Ckll.—♀ scale about $\frac{1}{2}$ mm. diam., slightly convex, circular to very broad pyriform, pitch-black, with large uncovered exuviae, which may be slightly greenish or brownish. ♀ with four small lobes, no groups of ventral glands; a cephalic protuberance after the manner of *personatus*. Near Phoenix, Ariz., on *Prosopis*.
- A. (*Chrysomphalus*) *smilacis* Comst.—♀ scale circular; exuviae central; color brown to very dark gray; exuviae marked by a white dot and ring. No grouped glands; 3 pairs of lobes, median smallest, second and third pairs notched. On *Smilax* at Woods Holl, Mass.
- A. (*Chrysomphalus*) *tenebricosus* Comst.—♀ scale very dark gray; the protuberance indicating the position of the exuviae marked by a white dot and concentric ring, but smooth and black in rubbed specimens. The scale is very convex, diam. $1\frac{1}{2}$ mm. ♂ scale oval. On *Acer rubrum*; Washington, D. C.
- A. (*Diaspidiotus*) *townsendi* Ckll.—♀ scale $1\frac{1}{2}$ mm. diam., circular or slightly oval,

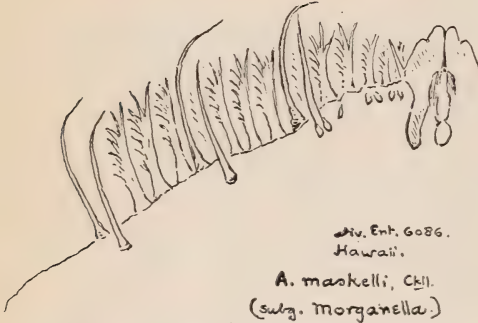


FIG. 14.—*Aspidiotus maskelli* (original).

- quite flat, thin, grayish-white; exuviae covered, pale orange. ♀ orange; 2 pairs of rounded lobes, four groups of ventral glands, cephalolaterals 4 to 8, caudolaterals 5. On leaves of some tree. Coahuila, Mexico. (Bull. 4, Tech. Ser., Div. Ent., p. 32.)
- A. (*Hemiberlesia*) *ulmi* Johns.—♀ scale quite convex, whitish, exuviae orange-yellow. ♀ lemon-yellow, only one pair of lobes, no groups of ventral glands. On trunk of *Ulmus americana* at Urbana, Ill.

- Although Johnson found no ventral grouped glands, he alludes to eggs.
- A. (*Diaspidiotus*) *uvæ* Comst.—♀ scale flat, nearly circular, light yellow-brown; exuviae bright yellow, covered with a white secretion. ♂ scale elongated. ♀ with second and third pairs of lobes obsolete; grouped glands present. On grapevines, Indiana, etc.; on hickory in Florida.

Sandwich Islands.

- A. (*Morganella*, n. subg.) *maskelli* Ckll. n. sp. (Fig. 14.)—♀ scale 1 mm. diam., tolerably convex, circular to broad oval, pitch-black; exuviae concolorous, very inconspicuous, placed toward the side. ♀ with no groups of ventral glands. Differs from *A. longispinus* by the contiguous lobes, the first pair of spines short, three following pairs very long, and thirteen strongly serrated and divided plates on each side of the lobes. It is evidently what Maskell recorded as *A. longispina* in Trans. N. Z. Inst., xxvii, 38. Div. Ent. 6086, "on Ohia tree, from W. S. Wait, Kailua, N. Kona, Hawaii, 23 Dec., 1893." The subg. *Morganella* (after the describer of one of the species) will be known by the closely adjacent or contiguous median lobes, which are long and slender, the absence of other lobes, the anal orifice at base of lobes, and especially the very long spines.

Neotropical.

- A. (*Selenaspidus*) *articulatus* Morg.—♀ scale very flat, grayish-white, appearing orange or rufous in the middle, mainly from the insect showing through. The scale looks like that of *A. aurantii*, but if it is lifted up, the flat orange ♀, with a deep constriction between the cephalothorax and the abdomen, is easily seen with a hand lens sufficiently for identification. It occurs on the leaves of palms and on a variety of other plants. West Indies, Demerara, Mexico, and lately reported by Newstead from Lagos, W. Africa. (Ent. Mo. Mag., xxv, 352.)
- A. (*Chrysomphalus*) *biformis* Ckll.—♀ scale about 2 mm. diam., very dark brown, circular to broadly oval, depressed, granulose; exuviae nipple-like, dark red-brown, placed to one side of center. ♂ scale elongate. ♀ with three pairs of lobes. On orchids. Jamaica and Trinidad. Also from Central America; the specimens showing four groups of ventral glands, rather scattered, cephalolaterals 4 or 5, caudolaterals 5.
- var. *cattleyæ* Ckll.—Exuviae black. On *Cattleya bowringiana*. Jamaica. (Gard. Chron., May 6, 1893, p. 548.)
- var. *odontoglossi* Ckll.—Exuviae pale, black when rubbed. On *Odontoglossum grande*. Jamaica. (Gard. Chron., May 6, 1893, p. 548.)
- A. (*Chrysomphalus*) *bowreyi* Ckll.—♀ scales crowded on the plant, elongate, gray, with the blackish exuviae toward one end. ♀ with three pairs of lobes, none very prominent, margin serrate beyond the lobes; four groups of ventral glands, cephalolaterals about 7, caudolaterals about 8. On *Agave rigida*. Jamaica. (Ent. News, 1894, p. 59.)
- A. (*Hemiberlesia*) *crawii* Ckll.—♀ scale about 2 mm. diam., circular, moderately convex, dull reddish-gray, rather pale; exuviae nearly marginal, concolorous, inconspicuous, except the first skin, which is marked by a little shining yellowish prominence. Scales largely covered by the red-brown epidermis. Removed from the twig they leave a conspicuous white mark. ♀ similar to *cydoniæ*; four groups of ventral glands, caudolaterals 4, cephalolaterals 5. On twigs of grapevine from Mexico, found by Mr. Alex. Craw in the course of his quarantine work. The passenger who brought the plants said they were sarsaparilla, but Mr. Craw thinks it is grapevine, and I am of the same opinion.
- A. (*Chrysomphalus*) *dictyospermi* Morg.—♀ scale grayish-white, depressed, oval, exuviae central, light yellow, center of larval skin dark orange. ♀ with three pairs of lobes; a conspicuous pair of long, serrated plates laterad of third lobe. On *Dictyospermum album*. Demerara. (Ent. Mo. Mag., 1889, p. 352.) There are four groups of ventral glands, cephalolaterals 3 or 4, caudolaterals 2. It occurs as a hothouse species in the United States.
- var. *arecæ* Newst.—♀ scale more circular, deeper colored, with a nipple-like prominence surrounded by a depression, beyond which is a strong circular ridge. On *Areca triandra*. Demerara. (Ent. Mo. Mag., 1893, p. 185.)
- var. *jamaicensis* Ckll.—♀ scale more circular, red-brown, no conspicuous central depression or ridge. Jamaica. On *Cycas* and rose.
- A. (*Diaspidiotus*) *diffinis* Newst.—♀ scale convex, slightly elongate, grayish-brown, exuviae covered, brown when rubbed. ♀ with three pairs of lobes, plates and ventral grouped glands wanting. Demerara. (Ent. Mo. Mag., 1893, p. 186.)
- var. *lateralis* Ckll.—♀ with distinct plates. Jamaica, on *Jasminum*. This is very near to *punicæ*, but the scale is brownish-white to brown, with the exuviae away from the center, and the groups of ventral glands seem to be absent.
- A. (*Chrysomphalus*) *ficus* Ashm.—♀ scale circular, 2 mm. diam., black or blackish, with the covered exuviae reddish or orange. ♀ with three pairs of well-developed lobes and four groups of ventral glands. On *Ficus nitida* and *Citrus*. Florida, Cuba, Mexico, Australia, Ceylon, Egypt. It lives on a great variety of plants. Mr. Pettit sent it to me from the Shaw Botanic Garden, St. Louis, on *Laurus virginiana*. It is common in the West Indies. Mr. Hy. Tryon states

that he bought in Brisbane some imported American apples which had numerous *A. ficus* on the rind; but did he perhaps mistake the species? Its food plants at Brisbane he says are orange, *Myrtus hillii*, camphor laurel, *Atlantia buxifolia*, and *Castaneospermum*.

- A. (*Aspidiotus* s. str.?) *hartii* Ckll.—♀ scale subcircular to oval, about $1\frac{1}{2}$ mm. diam., moderately convex, dull brownish-gray, with a slight purplish tint (*sacchari* is similar), exuviae shining pale straw-color. ♀ with two pairs of well-developed lobes, branched plates, five groups of ventral glands. On yam tubers. Trinidad, W. I.

var. *luntii* Ckll.—Median lobes entire, as in *hartii*; no groups of ventral glands. Trinidad. The median lobes of *sacchari*, which this resembles, are very distinctly notched.

- A. (n. subg.?) *latastei* Ckll.—♀ scale about $1\frac{3}{8}$ mm. diam., circular, strongly convex, concentrically ridged, white, with the covered pale orange exuviae to one side. ♀ with median lobes large, wide apart, second small, third almost obsolete; four groups of ventral glands, of 5 each. Chile.

- A. (*Morganella*) *longispinus* Morg.—♀ scale dark, convex, less than a mm. broad; exuviae central, covered, inconspicuous. ♀ with only one pair of lobes, these long, notched without; long simple plates, and very long spines. On *Cupania sapida*. Demerara. (Ent. Mo. Mag., xxv, 352.)

- A. (*Chrysomphalus*) *mangiferae* Ckll.—♀ scale circular, flattened, with central, covered, nipple-like exuviae, which are reddish. Median lobes largest, second pair nearly as large, third pair small, fourth rudimentary; a pair of very large spine-like plates in the region of 3rd and 4th lobes. On leaves of mango. Jamaica. (Journ. Inst. Jamaica, i, 255.)

- A. (*Chrysomphalus*) *mimosae* Comst.—♀ scale resembling that of *tenebricosus*; very dark gray, convex, exuviae covered, its position marked by a white dot and ring. 3 pairs of lobes; no group of ventral glands. On *Mimosa*; Tampico, Mexico. (2nd Cornell Rep., 1883, p. 62.)

- A. (*Melanaspis*) *nigropunctatus* Ckll.—Much like *A. obscurus*. ♀ scale 3 mm. diam., dirty gray; exuviae sublateral, pitch-black, with a narrow reddish margin; at first covered by a film of whitish secretion. ♀ with five groups of ventral glands, cephalolaterals 16 or more, caudolaterals 10 or 11, median 7 or 8. On "trueno," San Luis Potosi, Mexico. (Bull. 4, Tech. Ser., Div. Ent., p. 31.)

- A. (*Hemiberlesia*) *palmæ* Morg. & Ckll.—♀ scale much like that of *rapax*. ♀ differing by the distinct though small second and third lobes, median lobes wider apart, plates longer and much branched at tips, 4 groups of ventral glands. On cocoanut and banana, and rarely on other plants. West Indies.

- A. (*Mycetaspis*) *personatus* Comst.—♀ scale very small and convex, circular, dark gray or black. No groups of ventral glands. West Indies.

- A. (*Diaspidiotus*) *punicæ* Ckll.—♀ scale circular or nearly so, white, first skin shining metallic. ♀ orange, median lobes large and prominent, second pair small, third rudimentary; grouped glands present. ♂ dull yellow. On pomegranate in Jamaica; on cocoanut in Dominica. (Journ. Inst. Jamaica, i, 255.)

A variety of this on a palm at the Department of Agriculture, Washington, D. C. (Div. Ent., 6982), has broader lobes and a flatter scale. It appears to be identical with the form found by Mr. Barber on cocoanut in Dominica. This is a good deal like the Ceylonese form, which Green calls *A. cydoniæ*; and while *punicæ* and *cydoniæ* seem sufficiently distinct, with the var. of *punicæ* and the Ceylonese *cydoniæ* there is formed a sufficiently continuous series to call for further investigation. Whatever may be the final result as to the status of the species concerned, the interesting fact remains that here we have *Diaspidiotus* running completely into *Hemiberlesia* as it passes southward. Another related species is *A. greenii*.

- A. (*Chrysomphalus*) *reniformis* Ckll.—♀ scale circular, diam. 2 mm., flat, pale reddish-brown; exuviae concolorous or slightly darker, covered, but both skins very

distinctly visible, large, laterad of the middle; first skin when rubbed shining coppery. ♀ reniform, with four very low, broad, inconspicuous lobes, 4 groups of ventral glands, cephalolaterals 8, caudolaterals 4 to 7. Tehuantepec City, Mexico. Collected by Prof. Townsend.

- A. (*Aspidiotus* s. str.?) *sacchari* Ckll.—♀ scale white, becoming grayish, more or less oval, first skin brown, second orange. ♂ scale elongate. ♀ very pale yellowish, with a slight pink tinge; median lobes rather large, 2nd pair smaller, 3rd rudimentary. On sugar cane, Jamaica. (Journ. Inst. Jamaica, i, 255.)
- A. (*Chrysomphalus*) *scutiformis* Ckll.—♀ scale superficially rather like *A. ficus*, but large, very flat, with large orange exuviae, not nipple-like. The scales are occasionally nearly white. ♀ very much like *persea*. On *Citrus*, etc., Mexico.
- A. (*Hemiberlesia*) *tricolor* Ckll.—♀ scale $1\frac{3}{8}$ mm. diameter, approximately circular, very little convex, white with a brownish stain; exuviae central or sublateral, covered by a film of secretion; first skin black or dark brown, second skin deep orange. ♀ with only a single pair of lobes, these large; no groups of ventral glands. Allied to *ulmi* and *rapax*. Salina Cruz, Mexico. Collected by Prof. Townsend.
- A. (*Chrysomphalus*?) *yuccæ* Ckll.—♀ scale oval, dirty whitish; exuviae covered, inconspicuous, pale brown; when rubbed becoming very conspicuous, dark brown or black. ♀ with three pairs of lobes, only the median well developed. On *Yucca*. Coahuila, Mexico. (Bull. 4, Tech. Ser., Div. Ent., p. 32.)

Fiji Islands.

- A. (subg. nov.?) *vitiensis* Mask.—♀ scale grayish white, occurring thickly massed; exuviae subcentral, yellow. ♀ with very large, widely apart, median lobes, and others smaller; four conspicuous forked plates; four groups of ventral glands, caudolaterals about 15, cephalolaterals 6 to 10. On various forest trees. (N. Z. Trans., xxvii, 40.)

New Zealand.

(Most of the New Zealand and Australian species seem not to fit well in the subgenera of the Northern Hemisphere. It will be necessary to make a special study of them before they can be classified subgenerically.)

- A. (subg.?) *atherospermæ* Mask.—♀ scale circular, flat, brown; exuviae forming a lighter protuberance in center. ♀ light yellow; several lobes, the two median pairs largest; scale like serrated plates; four groups of ventral glands. The ♂ scale is oval. On *Atherosperma*. New Zealand. (N. Z. Trans., xi, 198.)
- A. (*Aspidiotus* s. str.?) *carpodeti* Mask.—♀ scale usually light brown but rather variable, convex, circular; exuviae central. ♀ with large median lobes, second pair much smaller; four groups of ventral glands. ♂ scale narrow, with parallel sides. On *Carpodetus* and *Vitex*. (N. Z. Trans., xvii, 21.)
- A. (subg.?) *corokiæ* Mask.—♀ scale circular, slightly convex, yellow or (rarely) white; exuviae central, yellow. ♀ with no distinct groups of ventral glands. On *Corokia*. (N. Z. Trans., xxiii, 2.)
- A. (subg.?) *dysoxyli* Mask.—♀ scale circular, somewhat convex, brown. ♀ bright yellow; six lobes, of which only the median two are conspicuous; four groups of ventral glands. ♂ scale oval. On *Dysoxylon spectabile*. (N. Z. Trans., xi, 198.)
- A. (subg.?) *sophoræ* Mask.—♀ scale nearly circular, flat, bluish gray. ♀ greenish-yellow; median lobes conspicuous, plates as in *nerii*, five (sometimes four) groups of ventral glands. ♂ scale oval. On *Sophora tetraptera*. (N. Z. Trans., xvi, 121.)

Australia.

A. (subg. ?) acaciæ Morg.—♀ scale circular, convex; exuviae central, orange-yellow; diam. of scale about 1 mm. ♀ with one pair of lobes, no groups of ventral glands. On *Acacia pycnantha*. Tasmania. (Ent. Mo. Mag., 1889, p. 353.) Maskell reports it on *Eucalyptus* from New South Wales.

var. *propinquus* Mask.—Exuviae deeper red. ♂ scale elliptical, white. ♂ dark red. On *Acacia* and *Hakea saligna*, New South Wales. (N. Z. Trans., xxv, 205.)

A. (subg. ?) bossiæ Mask.—♀ scale circular, convex, dirty white to yellow, sometimes dark brown, soft and woolly looking; exuviae central, very small and inconspicuous, yellow. ♀ dark brown, with two rounded lobes, and a second pair rudimentary; no groups of ventral glands. On *Bossiea procumbens*. (N. Z. Trans., xxiv, 11.)

A. (subg. ?) casuarinæ Mask.—♀ scale dark yellowish-brown, circular, rather convex; exuviae yellow. ♀ yellow, 6 lobes, no groups of ventral glands. ♂ scale elongated. On *Casuarina equisetifolia*. (N. Z. Trans., xxvi, 66.)

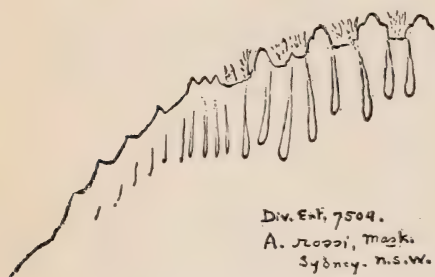


FIG. 15.—*Aspidiotus rossi* (original).

A. (subg. ?) ceratus Mask.—♀ scale snow white, circular, convex, usually occurring massed; exuviae central, faintly yellow, with a white covering. ♀ orange, two lobes only, with a pair of club-shaped processes arising from their inner bases; no groups of ventral glands; a peculiar widely bifid plate on the margin some distance from each lobe. On *Acacia stenophylla*. (N. Z. Trans., xxvii, 39.)

A. (Chrysomphalus) cladii Mask.—♀ scale rich dark brown, the margin orange-

red, and the central exuviae dark yellow. ♂ scale elongated. ♀ with no groups of ventral glands. On *Cladium*. (N. Z. Trans., xxiii, 3.) On aloe in Natal, as well as various localities in Australia, where it occurs on *Xerotes* and *Lepidosperma* as well as *Cladium*.

A. (subg. ?) eucalypti Mask.—♀ scale circular, slightly convex, dirty white; exuviae central, very inconspicuous. ♀ with large median lobes; no groups of ventral glands, but rows of pores along the margins of the hindmost segments; a deep constriction behind the cephalothorax, after the manner of *articulatus*. ♂ scale narrow, elongated; exuviae terminal, as in *Diaspis*. On *Eucalyptus*. (Tr. Roy. Soc. S. Australia for 1888.)

var. *comatus* Mask.—Distinguished by the nonincised lobes and the longer hairs in couples. Found on *Eucalyptus viminalis*. (N. Z. Trans., xxviii, 385.)

A. (Chentraspis.) extensus Mask.—♀ scale dirty yellow or brown, convex, first skin black. ♀ dark brown, with a single pair of contiguous lobes, after the manner of *Chionaspis minor*; no groups of ventral glands. ♂ dark brown. On *Eucalyptus capitellata*. (N. Z. Trans., xxvii, 41.)

A. (Aspidiotus s. str.) fimbriatus Mask.—♀ scale circular, flat, very thin, first skin uncovered. ♀ yellow, three pairs of lobes, scale-like plates; four groups of ventral glands, cephalolaterals and caudolaterals each of about 10 to 14. On *Eugenia smithii*. (N. Z. Trans., xxv, 208.) Described as a doubtful *Diaspis*, on account of the elongated form of the ♀.

A. (Chrysomphalus) fodiens Mask.—♀ scale circular, slightly convex, grayish or reddish-brown; exuviae central, bright orange, forming a slight boss, often covered with a thin grayish coating. ♀ orange, 6 lobes, scale-like serrated plates; 4 groups of ventral glands, not over 5 orifices in a group. Very near to *cladii*, but smaller. On *Acacia*. (N. Z. Trans., xxiv.)

- A. (*Phaulaspis*) hakeæ** Mask.—♀ scale circular, slightly convex, grayish-white; exuviae dark orange, central. ♀ orange-yellow, no lobes in adult, but four lobes in second stage; no groups of ventral glands. ♂ dark red. Related to *A. acaciæ*. On *Hakea*. (N. Z. Trans., xxviii, 384.)
- A. (*Chrysomphalus*) rossi** Mask—Fig 15.—♀ scale normally circular, very slightly convex, deep dull brown, almost black; exuviae central, small, forming a little boss which is sometimes yellowish. ♀ with 6 lobes; 4 groups of ventral glands, not over 8 orifices in a group. On oleander, *Eucalyptus*, *Ricinocarpus*, etc. Also in Ceylon, on *Capparis*. (N. Z. Trans., xxiv, 11.)
- A. (*Aspidiotus* s. str.) subrubescens** Mask.—♀ scale reddish-brown, subcircular, flat; exuviae central, forming a small slightly elevated boss. ♂ scale white. ♀ with 6 lobes, and serrated plates; four groups of ventral glands. On *Eucalyptus* (N. Z. Trans., xxiv, 9); on *Pittosporum* from Australia (Div. Ent., No. 7399).
- A. (*Chentraspis*) unilobis** Mask.—♀ scale whitish, but usually blackened by fungus growth, circular, slightly convex; exuviae central, orange. ♀ dark orange, with a single, median, lobe, after the manner of *Chionaspis quercus*; no groups of ventral glands. On *Acacia*. (N. Z. Trans., xxvii, 40.)
- A. (subg. ?) virescens** Mask.—♀ scale subcircular, flat, grayish-white; exuviae subcentral, first skin distinctly green, second greenish in middle and yellowish on border. ♀ yellow with a greenish tinge; six lobes, not close together; serrated scale-like plates; 4 groups of ventral glands, cephalolaterals of 17 to 21, caudolaterals 8 to 13. On *Eugenia smithii*. (Tr. N. Z. Inst., xxviii, 384.)

Oriental.

- A. (*Mycetaspis* ?) artocarpi** Green.—♀ scale less than 1 mm. diam., blackish, very convex; first skin exposed, central, dark brown with a pale reddish margin. Scale leaving a white scar surrounded by a black ring, after the manner of *personatus*. ♀ deeply constricted between cephalothorax and abdomen, four pairs of tooth like lobes, no plates, no grouped ventral glands. On leaves of *Artocarpus integrifolius*. Bombay. (Ent. Mo. Mag., 1896, p. 200.)
- A. (*Aspidiotus*, s. str.) excisus** Green.—♀ scale convex, of irregular outline, thin, semi-transparent, whitish or very pale ochreous; exuviae yellow, approximately central. ♀ with the median lobes sunk in a deep, squarely cut recess, an exaggeration of the condition in *A. destructor*; four groups of ventral glands, cephalolaterals 8 to 15, caudolaterals 7 to 9. On leaves of *Cyanotis pilosa*. Ceylon.
- A. (*Diaspidiotus*) greenii** Kkll.—See fig. 7. This is founded on the supposed *cyanophylli* found by Green on *Cycas* at Kandy, Ceylon, specimens having been kindly sent by Mr. Green.*
- A. (n. subg.) inusitatus** Green.—♀ scale very large, flattish, becoming elongated, even to $7\frac{1}{2}$ mm. long, brownish white or brownish fulvous; exuviae yellow, more or less concealed. ♀ with no lobes, and no grouped ventral glands. On bamboo. Ceylon. (Coccidæ of Ceylon, p. 49.) I have not examined specimens of this

* Since writing the above I have examined specimens of an *Aspidiotus* on cocoanut palms from Mazatlan, Mexico, forwarded by Mr. Alex. Craw. These are evidently Green's supposed typical *cyanophylli*, but they are allied to *Diaspidiotus*, having the incisions between the lobes very well marked. The glands in the groups are few, cephalolaterals 4 or 5, caudolaterals 3. After studying these insects, I begin to feel less sure regarding *cyanophylli* than I had been. They certainly may be the insect described by Signoret, notwithstanding certain discrepancies. They also agree excellently with Comstock's *cyanophylli*, except that Comstock not only fails to figure the incisions, but in his table places the species in the section without them. If the examination of Signoret's types eventually proves that the present insect really is *cyanophylli*, then the name *greenii* will have to be confined to the variety from *Cycas*, on which it is primarily based. But in the meanwhile, I should prefer to include the Mazatlan insect under *greenii*. The species is probably of neotropical origin.

curious species; perhaps Mr. Green will propose a subgeneric (or generic) name for it.

- A. (*n. subg.*) *moorei* Green.—♀ scale $2\frac{1}{2}$ mm. diam., rugose and colored like the bark on which it rests; exuviae reddish-brown. ♀ reddish-brown, skin entirely chitinous, body divided by deep constrictions into three subequal parts, three pairs of lobes, plates apparently absent, no grouped ventral glands; long chitinous processes arising from the first interlobular interval, but none in the second or beyond. On bark of *Grislea tomentosa*. Madras. (Ent. Mo. Mag., 1896, p. 199.)
- A. (*Cryptophyllaspis*) *occultus* Green.—♀ pale yellow; no groups of ventral glands. In minute galls on leaves of *Grewia orientalis*. Ceylon. The reader should refer to Green's "Coccidæ of Ceylon," p. 41, and Pl. XI, for an account of this very remarkable insect.
- A. (*subg.?*) *orientalis* Newst.—♀ scale about $1\frac{1}{2}$ mm. diam., brownish-yellow or straw color; exuviae covered by a nipple-like prominence which is darker than the rest. ♀ with three pairs of lobes, plates simple and hair-like, four groups of ventral glands of about 5 each. Madras. (Ind. Mus. notes, iii, 6.)
- A. (*Diaspidiotus*) *osbeckiæ* Green.—"Allied to *nerii*," but scale opaque, brownish, and marginal fringe of ♀ different. On stems of *Osbeckia*. Ceylon. The excellent figures in Green's work show that this species really belongs with *Diaspidiotus*, and therefore is only superficially like *nerii*. The median lobes are fairly wide apart, and the second lobes well trilobed; there are four groups of ventral glands, and a single orifice representing the fifth group.
- A. (*Aspidiotus s. str.*) *putearius* Green.—♀ scale round, flat, or slightly concave "forming an operculum to the pit-like depression in which the insect rests;" color very pale brownish ochreous, semiopaque; exuviae central, pale yellow. ♀ without grouped ventral glands. On *Strobilanthes*. Ceylon. This insect is of interest as showing the first stage toward gall formation, the advanced or completed stage of the same process being exhibited in the extraordinary *A. occultus*. The Australian *A. fodiens*, belonging to a different group, forms pits in the leaves of *Acacia*, but no gall-inhabiting *Aspidiotus* is yet known from Australia.
- A. (*Pseudaonidia*) *theæ* Mask.—♀ scales clustered thickly on twigs, as nearly circular as their numbers and position will permit, slightly convex, light brown, with a very thin coat of white secretion; exuviae yellow, very small, near the margin. ♀ brown; four lobes, the second pair smaller; 4 large groups of ventral glands. On tea plant. India. The insect has a patch of "lattice work" on dorsal surface of ♀, after the manner of *Ischnaspis*. This is not *A. theæ* Green, "Insect pests" (1890), p. 13, which consists of female *Howardia biclavis*, with the ♂ of some other species, apparently a *Chionaspis*.
- A. (*Aspidiotus s. str.*) *transparens* Green.—There are four groups of ventral glands, cephalolaterals 6 to 11, caudolaterals 4 to 6. Ceylon, on tea, etc., now referred by Green to *latoniæ*, but very likely distinct.
- A. (*Pseudaonidia*) *trilobitiformis* Green.—♀ scale broad and flat, opaque, reddish-brown. ♀ with the segments strongly marked, a deep transverse groove behind the cephalic portion; hind portion with a well-marked reticulated patch. On leaves of *Dalbergia*. Ceylon. Mr. Green says of this: "Very closely allied to (possibly only a variety of) *A. theæ* Maskell." I do not think the affinity is so very close, though they have some striking features in common. I think *duplex* is closer to *theæ*.

Ethiopian.

- A. (*subg.?*) *maculatus* Newst.—♀ scale pure white, rather thick; exuviae black, forming a large, conspicuous, central spot. ♀ with two pairs of lobes, median minute, rounded, second pair greatly elongated, plates well developed, no groups of ventral glands. Lagos. (Ent. Mo. Mag., 1896, p. 133.)

Patria Incerta.

- A. (*Aspidiotus s. str.*) *aloes* Boisd.—♀ scale white; exuviae central and yellow. Median lobes large; grouped glands present. Allied to *nerii*. On *Aloe umbellata*, Europe. (Signoret, Essai, 1869, p. 114).
- A. (*Aonidiella*) *aurantii* Mask.—♀ scale light gray, but appearing orange or reddish from the insect showing through; exuviae marked by a nipple-like prominence. ♀ reniform, three pairs of lobes, no groups of ventral glands. On *Citrus* trees in California, Australia, and the western Mediterranean region. On *lignum-vitæ* principally, never on *Citrus*, in Jamaica. A variety on *Podocarpus* in Japan, collected by Mr. Takahashi at Tokio. New Zealand, Fiji Is., Sandwich Is., Samoa, Tonga, New Caledonia; on cocoanut in Central America; on *Taxus* in Italy; on *Citrus japonica* at the University of Arizona, sent by Prof. Toumey.
- var. *citrinus* Coquill.—A yellow variety. California; Japan. According to Howard, this occurs on the leaves and fruit, never on the bark. See *Insect Life*, Feb., 1894, p. 228. Howard records three parasites from *v. citrinus*, all different from the three bred from typical *aurantii*.
- A. (*Aspidiotus s. str.*) *buddleiæ* Sign.—♀ scale circular, white; exuviae yellow. Ventral grouped glands present. On *Buddleia salicina*, hothouses of the Luxembourg. Maskell reports it on *Acacia* in New Zealand.
- A. (*Aspidiotus s. str.?*) *chamæropsis* Sign.—♀ scale elongated, transparent; exuviae yellow and to one side. Lobes terminated by long hairs; grouped glands present. On *Chamærops australis*. (Essai, 1869, p. 118.)
- A. (*Aspidiotus s. str.*) *cyanophylli* Sign.—♀ scale circular, brownish yellow; exuviae central, bright yellow but covered by white secretion. Median lobes large; plates long and branched, 4 small groups of ventral glands, 3 to 5 in a group. On *Cyanophyllum*, Paris (Signoret); on *Ficus*, U. S. (Comstock, Cornell Rep. 1883, p. 59). On palm and *Cycas* in Ceylon, according to Green, but his insect is a different species, *A. greenii*, n. sp., at least so far as the form sent to me is concerned.
- A. (*Aspidiotus s. str.*) *cycadicola* Boisd.—♀ scale circular, white; exuviae central, yellow; median lobes large; grouped glands present. ♂ with the thoracic band large. On *Cycas revoluta*, Europe. (Signoret, Essai, 1869, p. 119).
- A. (*Chrysomphalus*) *degeneratus* Leon.—♀ scale greenish, convex, about 1½ mm. long. ♀ pale yellow, three pairs of lobes; serrated plates; chitinous processes at base of lobes hardly longer than the lobes; four groups of ventral glands, not over 4 in a group. On leaves of *Camellia japonica*. Italy. (Riv. Pat. Veget., IV, 345.)
- A. (*Aspidiotus s. str.*) *destructor* Sign.—♀ scale circular, flat, yellowish or whitish; exuviae large, central. ♀ with three pairs of lobes, or even a fourth clearly distinguishable, and scale-like divided plates; the level of the tips of the median lobes below or at any rate not above that of the tips of second lobes. *A. fallax* Ckll. and *cocotis* Newst. are the same. On palms and various other plants. West Indies, Demerara, Bourbon, Marquesas Islands, Laccadive Islands. Distinguished at once from *nerii*, to which it is closely allied, by the larger exuviae and the short median lobes not extending beyond the tips of the second lobes. The var. *fallax*, on mango in Antigua, shows the four pairs of lobes. (See Ent. Mo. Mag., March, 1894, p. 57.)
- A. (*Aspidiotus s. str.*) *epidendri* Bouché.—Resembles *nerii*, but differs in the ♂. On *Epidendrum*, Europe. (Signoret, Essai, 1869, p. 121.) Maskell reports it on *Acacia* in New Zealand.
- A. (*Aspidiotus s. str.?*) *kennedyæ* Boisd.—Resembles *nerii*. On *Kennedya*. (Nomen seminudum.)
- A. (*Aspidiotus s. str.*) *lataniæ* Sign.—♀ scale a little elongated, clear yellow, translucent at center; exuviae large. Median lobes large; four groups of ventral glands. On *Latania*. A hothouse species in Europe. Green reports it from Ceylon, but it is not certain that his insect is the true *lataniæ*.

- A. (*Chrysomphalus*) *minor* Berl.—♀ scale brown, convex, very little over 1 mm. diam. ♀ yellow, three pairs of lobes, serrated plates; a couple of long plates laterad of third lobe, after the manner of *dictyospermi*; four small groups of ventral glands, not over 4 to a group. On leaves of *Pandanus*, in hort. Italy. (Riv. Pat. Veget., IV, 346.) This seems to me to be identical with *A. dictyospermi* var. *jamaicensis*; if not, it is at least extremely close to it.
- A. (*Aspidiotus* s. str.) *myrsinæ* Sign.—Allied to *nerii*. On *Myrsina retusa* in the hot-houses of the Luxembourg.
- A. (*Aspidiotus* s. str.) *nerii* Bouché.—♀ scale flat, whitish; exuviae exposed, central or nearly so, dull orange yellow. ♀ with three pairs of lobes, scale-like plates; four groups of ventral glands, caudolaterals about 7, cephalolaterals about 9. On oleander, *Melia*, *Yucca*, and a variety of other garden plants, very widely distributed, but not universal; very rare in the West Indies, only once found, viz: On olive in the Botanic Gardens, Grenada. Elsewhere in the neotropical region, Lataste found it at Santiago, Chili, while it occurs in several localities in Mexico. It is common enough in the United States. Berlese appears to have demonstrated what was before suspected, that *nerii* is but a variety of *A. hederæ*.
- var. *limonii* Sign.—♀ with the end of the abdomen more elongated, and the plates larger, than in the type. Found on lemons in Europe. Also in the Sandwich Islands. (Essai, 1869, p. 125.)
- A. (*Aspidiotus* s. str.) *palmarum* Bouché.—♀ scale white, circular; exuviae reddish-yellow. Grouped glands present. On palms. Europe. (Nomen seminudum.)
- A. (subg. ?) *pandani* Sign.—♀ scale blackish-brown, center whitish. Grouped glands present. On *Pandanus utilis*. (Essai, 1869, p. 131.)
- A. (*Diaspidiotus*) *perniciosus* Comst.—United States (Ala., Ariz., Cal., Del., Fla., Ga., Idaho, Ind., La., Mass., Md., N. J., N. Y., N. M., Ohio, Oreg., Pa., Va., Washington, W. Va.), British Columbia, Australia, Sandwich Islands. (For full particulars see Bull. 3, n. s., Div. Ent. The San Jose scale; by L. O. Howard and C. L. Marlatt.)
- A species perhaps allied to *perniciosus*, but possibly new, was found by Prof. C. H. T. Townsend on *Fraxinus* at Brownsville, Texas. The scales were attacked by some parasite, and it proved impossible to satisfactorily describe or figure the species. The scale is more convex than *perniciosus*, the exuviae are dark; the median lobes are quite elongated.
- A. (*Aspidiotus* s. str. ?) *phormii* de Brème.—♀ scale white, circular; exuviae central. On *Phormium tenax* in Switzerland. (Signoret, Essai, 1869, p. 130.)
- A. (*Hemiberlesia*) *rapax* Comst.—♀ scale convex, gray, appearing yellowish from the contained insect; exuviae toward one side, marked by a dark brown or black spot. ♀ with one pair of large lobes; branched plates; no groups of ventral glands. On various trees, etc.; nearly cosmopolitan.
- A. (*Chrysomphalus*) *sphærioides* Ckll.—♀ scale circular, rather over 1 mm. diam.; moderately convex; dark reddish-brown, with the part covering the exuviae indicated by a pale raised ring; when rubbed the exuviae appear shining black. ♀ with three pairs of lobes; five groups of ventral glands, caudolaterals, 3; cephalolaterals, 4; median, 3. Said to be on New Zealand flax. Louisiana.
- A. (*Aspidiotus* s. str.) *spinosus* Comst.—♀ scale circular, very light brown or dirty white; exuviae central and covered. 4 groups of ventral glands, of not over 6 each; median lobes prominent; plates more or less notched; spines large. On camellia. Washington, D. C.
- A. (*Aspidiotus* s. str.) *vriesciæ* Sign.—Allied to *nerii*; scale more elongated, yellowish gray. On *Vriescia splendens*.
- A. (?) *osmanthi* Vallot, 1829, a white scale with central exuviae, found on *Olea fragrans*, is at best a *nomen seminudum*.

POSTSCRIPT.

Since this Bulletin went to press I have received an interesting note from Dr. G. Leonardi, to whom I had communicated some of my views by letter. One of the subgenera which I had proposed, having for its type *A. secretus*, proved to be identical with a new genus (*Odonaspis*) of Dr. Leonardi's. I therefore adopt his name and suppress my own; though it is to be remarked that if *Odonaspis* is from *οδονῶς-ἀσπίς* it is equivalent to *Odontaspis*, preoccupied by Agassiz. Dr. Leonardi goes on to say that he would refer *Melanaspis* to *Chrysomphalus*, *Xerophilaspis* to *Targionia*, and *Cryptophyllaspis* and *Selenaspis* to *Aspidiotus*, s. str., in which they will represent sections. The change of *Aspidites* to *Hemiberlesia* is assented to, and the generic value of *Chrysomphalus* and *Aonidiella* is maintained. At the same time Dr. Leonardi has published (Riv. Pat. Veget., 1897) a preliminary classification of *Aspidiotus*, dividing it into the following groups, which are all regarded as genera: *Aspidiotus*, *Aspidites*, *Chrysomphalus*, *Aonidiella*, *Targionia*, *Odonaspis*, *Chentraspis*, *Phaulaspis*—the last three new—and with *Aonidia* added. I can not at all agree with this classification, which throws into the same genus (*Aonidiella*) such diverse species as *A. aurantii*, *perniciosus*, and *mimosæ*, while it places *perniciosus* and *ancylus* in separate genera! However, it is intended only as a preliminary statement, and no doubt the author will greatly improve it in his detailed publication and explain away some of the apparent difficulties.

